Research Note 84-143

Developing a Field Artillery Training System Based on Devices and Simulations: Definition of the Gunnery Team Trainer

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This development of a concept and functional description of the Gunnery Team Trainer (GTT) is based on the results of analysis conducted under three separate tasks that comprise the initial part of this program. All of the earlier analyses were updated, and the revised products are incorporated into this report. The process of developing the GTT definition is described. A system definition of the GTT is presented, along with information about using it at the Field Artillery battery level. In addition, a representative set of fire mission procedures is included as a basis for conducting unit training exercises. (cont)

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The description of the GTT illustrates how it makes use of operational equipment and simulation to provide for effective training while controlling the expenditure of training resources.

The summary of the entire program (four tasks) which is included in this report and its Appendices will help to extablish other applications of the techniques.

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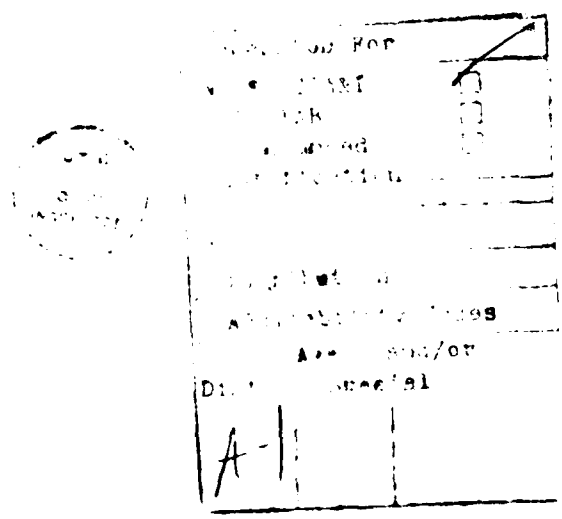
PREFACE

This report is the fourth and last of a series generated by the program to develop a Field Artillery training system based on devices and simulations. That system is now designated as the Gunnery Team Trainer. Each of the preceding reports documented a specific analytical phase of the program. This report is different. It describes the process and the output of the fourth program task but it also contains parts of the earlier reports that are directly relevant to the description of the Gunnery Team Trainer. Each of these incorporated parts has been revised and developed as this program matured toward its completion. Thus, while designated as the Task Four Report, this document represents the summation of the entire program.



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A very large number of the Officers, Enlisted personnel and Civilian employees of the Field Artillery School have given generously of their Field Artillery and training knowledge and expertise. We are grateful for their help and support. It is appropriate to acknowledge especially the guidance given us by LTC L.E. Stunkard, Major J.M. Haning, and Major Kieran McMullen. Their professional, practical insights have increased the potential utility of this program.

The Dunlap staff assigned to this program has consisted of Dr. Richard F. Bloom, John W. Hamilton, and Carol W. Preusser, Research Associate, working with Edward W. Bishop--the project Responsible Officer. Dr. Richard D. Pepler and Leroy L. Vallerie have also participated in the earlier parts of this work. The preparation and production of the products of this effort have been the responsibility of Frances B. Kowaleski and Janet C. Vartuli. The talent and dedication of each of these people has contributed to the quality of the program.

While we acknowledge the help and support of many people, the outcome of this program and the quality of its products are solely the responsibility of the Dunlap staff.

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I. INTRODUCTION

A. Background

Training for Field Artillery (FA) operations is a complex process. The artillery operation involves a wide range of human skills and makes use of a number of technologies. Artillerymen are called on to perform tasks ranging from the simple motor activities of handling ammunition to the relatively sophisticated tasks of planning, coordinating and controlling fire missions. The technologies include computer operation and digital communication as well as laser operation, while some artillery jobs are still based on simple mechanical principles. The FA training program at both the entry level and at the advanced unit level must be capable of dealing with the kind of diversity noted above. In addition to the problems created by the diverse nature of the tasks, FA training must cope with the fact that moving, emplacing and firing an artillery weapon requires a substantial quantity of resources. Thus, the selection of live-firing as a training medium is many times not acceptable. The cost of vehicle fuel is already high and not likely ever to move lower. Live ammunition is also expensive. To use live-firing safely in a reasonably realistic setting requires sizable range areas. This in turn raises the issue of environmental impact both on the range and in adjacent areas. Finally, the use of operational equipment in training does impose wear and tear that might adversely affect the readiness and reliability of the equipment.

Artillery training is, then, a complex job and if conducted with operational equipment, is fraught with a number of negative aspects, including potentially high costs for resources and risks to the environment and the community adjacent to the range. Compounding the effect of each and all of these problems is the growing demand for quality in training. This demand is created by the growth of current technology and the possible application of even more advanced technology. Finally, artillery training just as all military training must be responsive to the characteristics of the trainees. Thus, in addition to the problems and demands noted above, FA training must be adaptable to what at at times may be a wide range of trainee capability.

An approach to training that has the potential for coping with many of the above issues would have the following characteristics:

- The training requirements would be developed from a systematic analysis of the operational tasks.
- The training process would be performance-oriented deriving training objectives from operational performance standards.
- The training would be implemented to some appropriate optimum level through the use of training devices and simulations.

The research program to be reported here was initiated in at least partial response to the issues that are noted above. The program did not undertake to address the entire body of field artillery training but focussed on a critical

segment--the gunnery team during target engagement. The program emphasized the method for developing a system for training and is intended to have broad application to FA training system development.

In Section B, below, the scope and objectives of this program are presented. This is followed by a description of the analytical approach used in the program.

B. Program Scope and Objectives

1. Scope

The name that was given to this research program is Developing a Field Artillery Training System based on Devices and Simulations. This suggests the connotation of including all FA training and of totally synthetic means of training. It is actually the case that the scope was defined to include only the activities of the gunnery team during target acquisition and engagement. The title, "gunnery team," refers to the personnel assigned to a Battery Fire Direction Center (FDC) and Howitzer Section, plus the Fire Support Team (FIST) and observer (FO) personnel who are attached to the supported maneuver organization. In total, this includes 16 functional positions (jobs) that represent three Military Occupational Specialties (MOS): 13B, Cannon Crewman; 13E, Fire Direction Specialist; and 13F, Fire Support Specialist. The scope was further defined to include only the "integrated" operation of the gunnery team, which is to say, only those activities the individuals perform collectively. This excludes support tasks, such as maintenance, and any that are exclusively individual, such as use of individual protective equipment.

To help put this scope in perspective, it should be noted that the direct support missions of a howitzer battery are made up of four segments:

- Occupy which is all of the activity involved in the emplacement of that battery on a selected or designated site.
- Engage which includes all of the activities associated with the actual conduct of a fire mission.
- March Order which is the preparation to move from an occupied site.
- Move which is the transportation of the battery to a newly designated site.

While each of these four segments is important and there is a dependency among all of them, the critical functions of providing artillery fire occur in the Engage segment. Thus, the scope of the program focuses on the most significant part of the Artillery's overall mission. Also, the Engage segment is comprised of functions and tasks that are clearly unique to the Artillery. Within the Engage segment, the major functions performed by the gunnery team are:

- Locate targets.
- Initiate and coordinate fire missions.

- o Conduct technical fire direction.
- o Deliver fire.
- o Communicate and report.

These functions are implemented through a number of Soldier's Manual tasks for each MOS. These tasks formed the data base on which this program was built.

In terms of the research that was performed, the scope of this program was defined as follows: to develop and apply system and task analysis techniques to a selected baseline system leading to the development of a description of a system for training. The analytical processes were adapted from traditional techniques to provide the information needed to develop the training system specification. In the course of this program that system has come to be known as the Gunnery Team Trainer or GTT. That name will be used throughout this report.

2. Objectives

There are essentially two objectives to which this research was directed. First, the program was to develop the description of a system for training the gunnery team in the engagement mission segment to be applied at the unit level. Second, the program was to document and illustrate, for other applications, the analytical processes that were used. This report presents the Gunnery Team Trainer specification (first objective) along with the relevant analysis products. The analysis processes are described (second objective) in the earlier reports of this program (1, 2 and 3).*

*See References, page 51.

II. PROGRAM OVERVIEW AND ANALYSIS RESULTS

A. Overview of the Program

As indicated in the previous section, this program was structured as a sequence of analytical steps leading to a description of a system for training (i.e., the Gunnery Team Trainer). This approach follows the proven process of system development that is used in many contexts. It is, for example, consistent with the approach specified for use in the human factors development of military systems (4). That approach begins with the definition of a mission, for a new system, and proceeds through the definition and allocation of functions (among equipment, software and personnel). Following that, the human functions are analyzed to a level of detail from which personnel and training requirements, performance measures and conditions of performance can be identified. This approach is closely similar to the Analysis Phase of Instructional System Development, a process that has been extensively used in military training development. In this program, the analysis of the baseline system followed the concept of these specified approaches. Because the baseline is an operational system, the initial steps of mission definition and function allocation were not needed. The analytical process began with the compilation of task information and its analysis into training characteristics. One part of the analysis was devoted to the determination of the criticality and difficulty of tasks (in the baseline). The approach for that was adapted from an ARI method developed for the determination of training device requirements (11). The results of the baseline analysis permitted the definition of training requirements, performance measures and standards, and similar baseline attributes from which Gunnery Team Trainer characteristics were derived.

Administratively, the program was segmented into four tasks:

1. Baseline System Analysis
2. Training Analysis of the Baseline System
3. Evaluation of Training Devices and Simulations
4. Definition of the Gunnery Team Trainer

Figure 1 is a flow diagram of the entire program which shows the sequence of the several processes. It also indicates the administrative task under which each process was performed.

B. Analysis Results

The analytical processes and results that comprise the basis for the GTT description contained in this report are summarized below. As has been noted, each of the first three program tasks has been separately reported. This summary is provided primarily to give a frame of reference for the GTT material that follows. This summary will also help the reader better understand the products of earlier tasks that are incorporated in this report. For example, the OSD produced in Task One was the basis for the separate fire mission OSDs that are included here as a training guide for the GTT.

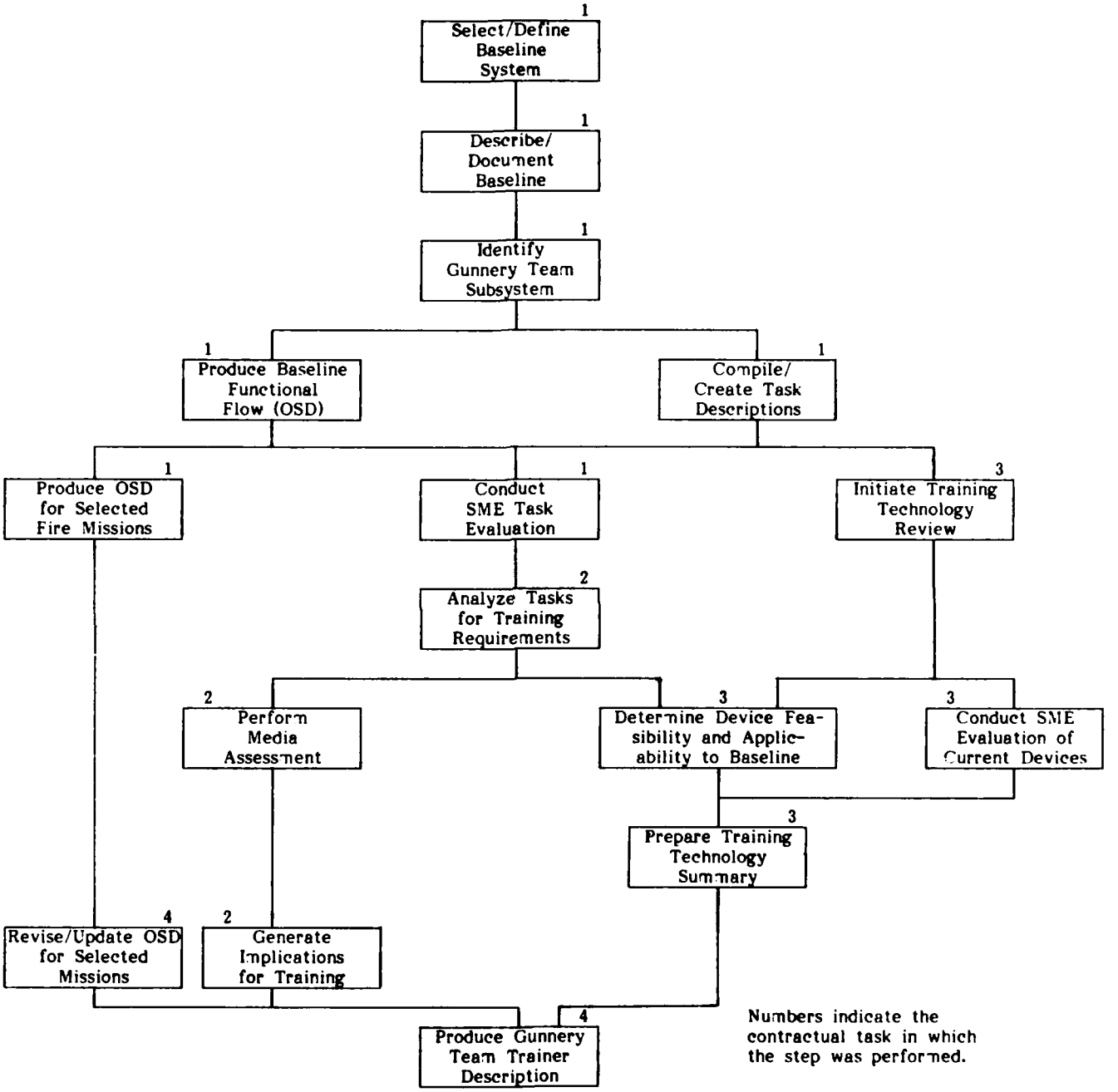

Figure 1. Program Flow Diagram

1. Task One Results

The first task in this program was completed and reported in September 1983. The purpose of that task was to analyze the baseline system, thereby developing the data base for subsequent tasks. A brief summary of that initial task is given here.

The method by which the baseline system was analyzed is of interest because both the product of this program and the method used are to be transportable to other Field Artillery applications. The analysis performed in Task One followed traditional task analysis procedures, such as one documented for the Army Instructional System Development (ISD) approach (12). The first phase of the ISD process, "Analyze," was followed to the extent applicable to this program. Lists of tasks performed by each section were compiled by combining ARTEP tasks and the related Soldier's Manual (SM) tasks. These were structured into an operational sequence diagram (OSD) which identifies the personnel who perform each task and shows the operational and communications flow among the tasks. It should be noted that this analysis included all of the tasks involved in a complete, representative fire mission, including all four segments: Occupy, Engage, March Order, and Move. Only tasks already described by the Army were to be used. However, for the Ground Laser Locator Designator (GLLD), the FIST DMD and the Battery Computer System (BCS), several "new" tasks had not been described by the Army and had to be derived from manufacturers' documentation and technical manuals. In total, approximately 260 tasks are included in the baseline description and about 10% are new. The task lists and OSD are to be refined in the last stages of this program. More new tasks may be identified and other changes may be made.

Next, an evaluation process was established to obtain Subject Matter Experts' (SMEs) assessment of the difficulty of each task and its effect on baseline system performance. The evaluation was based on a procedure developed for ARI in another program (11). It was performed by USAFAS personnel selected by the USAFAS representative to this program. A group of between 3 and 5 SMEs was selected for each section (FIST, FDC and HOWITZER). Each group was asked to review and confirm or correct the task data for its section. Under the guidance of contractor staff, the SME group then evaluated each task relative to each defined attribute. The SMEs were instructed to reach a consensus on each evaluation and were helped in this process by the contractor staff. The approach used to achieve consensus was not unlike the Delphi method. Whenever there was not initial unanimity of opinion, the SMEs discussed the differences among themselves with contractor staff guidance. The discussion was continued until the SMEs agreed upon a rating. Four task attributes were defined to be judged for each task:

- o System Performance Effects (or criticality) on a scale of 1-3.
- o Delay Tolerance (Does the task have to be initiated immediately upon receipt of the initiating stimulus?) on a scale of 1 or 2.
- o Task Difficulty on a scale of 1-4.
- o Practice Required on a scale of 1-5.

These attributes are judged to be sufficient to define a relationship between system performance and task performance and to establish the inherent difficulty of each task. The first two attributes listed above--System Performance Effects and Delay Tolerance--relate to the interaction between task performance and system performance. The second two relate to the inherent difficulty of the task. The rating scales are not measures, nor are they truly quantitative. The ratings are simply ordinal; for each attribute, the highest number represents the least desirable state, i.e., most effect on system performance, most difficult, most practice required and no delay tolerance. The number "one" denotes the other extreme, i.e., "no effect on system performance," etc. These ratings and definitions follow traditional evaluative ranking schemes, such as ISD and the earlier ARI study (11 and 12). Written definitions of each attribute and its rating scale were used in the SME task evaluation process.

When all of the SME groups had made their evaluations, it was found that they had not used the rating of 1--"no effect"--for System Performance Effects, and they had not used the rating of 1--"no practice required"--for Practice Required. Thus, the scale values actually obtained were:

- o System Performance Effects: 2 and 3
- o Delay Tolerance: 1 and 2
- o Task Difficulty: 1-4
- o Practice Required: 2-5

Because these attributes and ratings were definable in relatively simple and explicit terms, one can be confident that the SME assessments are acceptably valid. The focus of this program, however, is on more global training needs, and so a means for compiling the four attribute ratings was developed. This combined index is called the Training Requirements Index (TRI) and is an ordinal representation of the need for training. First, the two performance attribute ratings (System Performance and Delay) were added together and the two difficulty ratings were added together for each task. This produced two indices: "Performance Effects" with values of 3, 4 or 5, and "Task Complexity" with values of 4 through 9. The TRI could have been simply the sum of these two indices, but to give greater apparent scale distance and to emphasize the effect of extreme ratings, it was decided to square each of the combined indices and then add them. The resulting TRI thus has a possible range between 25 and 106. However, the highest TRI actually achieved was 89.

It is appropriate to think of the TRI as denoting a priority for training consideration. That is to say, any task with a high TRI should be considered for expenditure of training resources before a task with a low TRI. This is an ordering or priority, and no absolute values are implied. Also, the TRI addresses the characteristics of each task apart from all other tasks. Thus, in addition to the TRI, the functional relationships among tasks must be considered in making training decisions. For example, it is quite likely that a task which is performed in relative isolation, but which has achieved a high TRI, will be given different training consideration than a task with a comparable TRI which is performed as part of an integrated team activity. Also, of course, the available or potentially available means for training will help determine training resource expenditures.

In summary, the results of Task One are a task inventory and an Operational Sequence Diagram of the Baseline System and an evaluation of each task as to criticality/performance effects and difficulty. A summary index for priority in training consideration--TRI--is computed for each task. The total inventory and system OSD constitute a system description that is potentially useful in other Field Artillery applications beyond this program. That part of Task One that relates to the Gunnery Team in target acquisition and engagement became the data base for Task Two: Training Analysis.

The ultimate development of the OSD is in five representative fire mission OSDs. Each is a description of the gunnery team activities during the Engage segment. Together, they encompass the full range of fire missions that could be assigned to the baseline system. In the development of the GTT it was determined to be essential to deal with performance-based training derived from actual fire mission procedures. Thus, the specific fire mission OSDs are incorporated into the guidance for using the GTT. Therefore, they have been reproduced and are attached as Appendix A. These OSDs are current as of the date of this report and provide a complete description of the team's activity during Engage. Further guidance as to how they are used in the GTT is presented in Section VII, Utilization.

2. Task Two Results

Task Two was the Training Analysis of the Baseline System. It was devoted to the analysis of the Gunnery Team (Howitzer Section, Battery Fire Direction Center and Fire Support Team/Forward Observers) as it performs the Engage segment of a fire mission. The analysis was directed toward development of a detailed description of each Soldier's Manual task and subsequently the definition of training requirements and implications. Also, the applicability of representative media for training each gunnery team task was determined. The product of Task Two is made up of baseline analysis results as well as some generalized implications for a training system. That data base along with the Task Three results comprise the input to the development of the GTT description.

In Task Two, the detailed analysis of each Gunnery Team task was required to define the specific human performance (or behavior) that would have to be trained. This was accomplished by an Input-Process-Output (IPO) analysis which identified the specific component processes of each task, along with the performance measures and criteria as well as conditions of performance. As part of the IPO analysis process, information relevant to training was compiled onto a single data sheet. A total of 58 Soldier's Manual tasks was analyzed. These are all of the tasks that occur in any fire mission performed by the baseline system.

Following the IPO analysis, the task data were subjected to an analysis of training implications. As a first step, the baseline system performance requirements and measures of effectiveness were compiled from the IPO. This information describes what the baseline system personnel must do operationally and the criteria by which what they do can be evaluated. The information was compiled for each task at the level of detail produced by the IPO. These data are the last to be generated by analysis of the baseline. The

next step was to combine this information into statements of Implications (or General Requirements) for a training system. These statements describe the nature of the training, i.e., what behaviors are to be trained, and the criteria of time and accuracy to be used. For each Soldier's Manual task, four pieces of information were produced:

- o Overall training requirement statement.
- o Training implementation statement (specific skills and knowledge).
- o Time criteria.
- o Accuracy criteria.

The final part of the second task in this program was the Training Media Assessment. In that assessment each skill and knowledge listed in the Training Implementation statement was assessed separately. A representative array of six training media ranging from traditional classroom instruction to practice using operational equipment was defined. The extent to which each medium was judged to be feasible and appropriate for each implementation area was rated. The program staff made these judgments using a defined rating procedure and numerical scale.

The final product of Task Two consists of the data recorded on several analysis sheets for each of 58 Soldier's Manual tasks. There are data sheets for the Input-Process-Output analysis, the Training Implications Analysis, and the Training Media Assessment. This compilation of information became the data base for training device and simulation evaluation (Task Three). In the development of utilization guidance for the GTT, it has been determined that the data contained in the IPO analysis sheets would be useful to the GTT instructor(s). Those data provide a description of the specific performance that is required, down to a subtask or element level. The data also include the definition of appropriate performance criteria and measures. All of this information can and should be used in the planning and conduct of training. Therefore, the IPO analysis sheets--updated as of the date of this report--are attached as Appendix B. Further information about how they are used is contained in Section VII, Utilization.

3. Task Three Results

Task Three was devoted to an assessment of Field Artillery training devices and simulations, including existing as well as planned equipment and systems. The purpose of this assessment was twofold: to evaluate existing and developing devices for inclusion in the Gunnery Team Trainer, and to identify training device and simulation areas in which further development would be of value. The data base for this assessment was the compilation of analysis data for the 58 Soldier's Manual tasks produced in Task Two. This compilation extends over about 250 pages and represents the level of detail necessary for the analyses that were made early in the program. There is, however, a degree of repetition among the 58 tasks and their several subtasks. For example, communication--both voice and digital--is an essential component of virtually every task. In addition, the several tasks assigned to each section

often make use of the same equipment and/or substantially the same procedures. Setting and laying the howitzer, for instance, uses similar procedures for both elevation and deflection, and both use closely related components of the howitzer. Thus, there is a clear opportunity to aggregate these tasks into smaller sets based on functional, procedural and equipment similarities within each section. The value of this aggregation is that it allows a more comprehensive statement of training requirements, such as "operate the Digital Message Device (DMD)," and not "operate the DMD to designate a target for laser-guided munitions" or "... to request/adjust area fire," etc. The concept of aggregation also is compatible with the process of defining an integrated training system. Up to this point in the program, the analysis to an extensive level of detail was necessary to identify completely all of the behaviors to be trained, the relevant performance measures, etc. Now it is the objective of the program to reflect each of these requirements in an integrated system for training: the Gunnery Team Trainer. The process of aggregation resulted in a total of 12 performance statements, each of which is unique to a section, equipment and procedure. In addition, there is an "aggregated task" in each section that expresses the requirement for timely performance under stated environmental conditions. There are 6 aggregated tasks related to FIST/FO, 4 to FDC and 5 to Howitzer.

The assessment of training devices and simulations was made, then, on the basis of 15 aggregated tasks. This assessment also required the identification and definition of the devices and simulations (referred to in Task Three collectively as "technologies"). An extensive search of the FA literature and discussions with USAFAS personnel resulted in a set of 14 existing and 9 planned or developing technologies for assessment. A review of related documentation was made, and interviews with subject-matter experts (SMEs) at USAFAS were conducted on several occasions. This provided the descriptive information necessary for the analytical assessment, and the subjective information necessary for user reaction assessment, for each training device and simulation.

None of the existing training technologies was assessed as "Excellent" on any aggregated task. Those that were considered "Good" for certain tasks include:

- Firing Battery Trainer (FBT), for three of the five Howitzer Section tasks (communications using the GDU/SCA; aiming the howitzer; loading, firing and clearing the howitzer).

- Miniature Moving Target (MMT) with the M31 Subcaliber Trainer, for the one Howitzer Section task of loading, firing and clearing the howitzer and for three of the six FO/FIST Section tasks (using the G/VLLD; using the LRF; fire mission decision-making).

- Battery Computer System/Interface Training System (BCS/ITS), for one Howitzer Section task of communicating with the GDU/SCA, and for two of the four FDC Section tasks (using the BCS for RFAF messages; using the BCS for TACFIRE messages).

- o Battle Simulations for the one FDC Section task of mapping target information, and for two FO/FIST Section tasks (mapping target information; fire mission decision-making).

- o G/VLLD Trainer, for the one FO/FIST Section task of using the G/VLLD.

- o G/VLLD with TV Camera, for the one FO/FIST Section task of using the G/VLLD.

- o Training Set Fire Observation (TSFO), for the one FO/FIST Section task of mapping target information.

The rest of the training technologies were, at best, "Fair." Virtually all the devices are aimed at practicing skills at the Section level, although some (FBT, FASPR and TSFO) can be used in combination to accomplish a form of integrated (closed loop) training for the entire gunnery team. None of the technologies reviewed does a "Good" job in creating the various extreme tactical and environmental conditions necessary for complete and thorough training of the target acquisition and engagement tasks, and "Major" developmental efforts are foreseen if that capability is to be achieved. "Minor" to "Moderate" developmental efforts are seen as necessary to provide technologies that yield acceptably adequate training capabilities for every other task.

Some of the necessary improvements in training technology are being attempted with the devices and simulations currently under development. In this assessment, three of the nine developing technologies are considered to have potentially "Excellent" capabilities, at least in concept if not in practical implementation and prototype testing. Those items are the Indirect Fire Engagement Simulation (IFES), the Closed Loop Training Concept, and the Howitzer Recoil Simulator.

In the same vein, four of the developing technologies are considered to have potentially "Good" capabilities. They are the FA Fire Support Training System (FAFSTS), the FIST/FO Interactive Videodisc Trainer, the Copperhead Moving Target, and the Simulated Tank Antiarmor Gunnery System (STAGS).

In addition to the systematic assessment of training technologies, Task Three included a brief review of the "nontechnical," subjective factors that affect training device usage. This review was included as a reminder that adequate training technology of itself cannot insure successful development and use of training resources.

Because of their direct application to the description of the GTT, the two major products from Task Three have been attached to this report. Appendix C contains the information about the aggregated tasks summarized separately for each subsystem. Each summary shows the Soldier's Manual tasks that comprise each aggregated task. Also, the personnel who perform each aggregated task are identified, and the training media assessment results and TRI have been averaged for each aggregated task. The Task Three evaluation of training technology is also presented in summary tables, one for each subsystem.

III. TASK FOUR APPROACH

A. Objectives

As the final task in the program, the major objective of Task Four is to present a description of a Field Artillery training system. In addition, this task encompasses the revision and updating of the products of the earlier tasks. Thus, this report provides both a description of the Gunnery Team Trainer and a summary of the overall program. The objective of Task Four can be viewed as an integration of all of the analytical products into a training system context. In this task, then, the building blocks created by all of the earlier analyses are assembled into a system description: it is a process of synthesis. The specific training needs of the artillery are recognized in this process as are the basic precepts of good military training.

In addition to the basic objective described above, Task Four has a second objective of serving as a demonstration of the processes used in the program. This program was defined and carried out not simply as an exercise in analysis and synthesis. It is intended also to illustrate the processes that were used as being exportable to other Field Artillery training system development activities. Each of the three preceding task reports describes the specific processes that were used. These can serve as guides for the application of those processes in other settings. This report illustrates how the products of all the processes are combined.

The final aspect of the purpose or objective of Task Four is one that was adopted during the course of the program. From its inception, the program has been directed toward the development and use of an analytical process in defining a system for training. As the program developed, it became very clear that the definition, measurement and evaluation of gunnery-team members' performance would be a significant part of the training system. Briefly, the reason for this is that unit training (through the ARTEP) is presently related to large segments of performance (such as the team activity between receipt of a fire order and firing). While this provides an "ultimate" performance criterion, it does not always provide segments and measures of performance that are useful in training. Fully effective training requires the diagnosis of performance to establish training need and the evaluation of performance to assess training effectiveness. Both diagnosis and evaluation require performance definitions and measures at a finer level of detail than is given in the typical ARTEP statement. The earlier analyses identified team-members' performance at the appropriate level of detail, and the Gunnery Team Trainer specification is premised on the collection and use of such performance data. The GTT, then, also serves as a performance data collection means. With this characteristic in mind, it was accepted that one GTT objective would be to implement a performance data collection function for application in other areas of performance research.

B. Scope of Task Four

Task Four encompasses all of the synthesis and integration needed to combine the previous analytical results into a system for training. The content

of that system is comprised of the skills and knowledge needed by the gunnery team in performing the Engage segment of a Field Artillery indirect fire mission. The training system is to be performance based. It is to make the most appropriate use of training devices and simulations. Especially, it is to make use of current and emerging Field Artillery devices. In Task Four, the specification of devices and simulations is based first on the training effectiveness of such synthetic means. Second, the choice of devices and simulations, as well as the overall training system specification, is based on the conservation of scarce/costly training resources.

The scope of Task Four was never defined solely in terms of the amount of synthetic means to be used. It was not, for instance, defined as a totally synthetic (or surrogate) system. This aspect of scope was always defined to be the "appropriate amount" of synthetic training to meet the identified needs in the specific subject matter.

Finally, the scope of this task encompasses not only the derivation of a functional description of the GTT but also includes guidance for the use of the trainer. There is a description of how the GTT would be initialized and operated by the using unit. This guidance represents the "tailoring" or adaptation of the system's capability to each unit's needs. In addition, it is suggested that the exercise of representative fire missions be used as the basis for team training. The guidance in that regard consists of a set of descriptions of five representative missions. These consist of a mission narrative, a flow diagram depicting the functional and sequential relationships among all of the team's tasks, and the performance data that have been derived for each of the tasks.

C. Method

Task Four consists of five steps, each one of which represents a compilation of selected analysis results and the application of training expertise. There is a specific product from each step; these products taken together represent the full output of the task. The steps are illustrated in the flow diagram shown in Figure 2. The diagram also depicts the flow of input from the earlier program tasks.

1. Deriving System Requirements

As shown in the diagram, the derivation of GTT system requirements and the definition of a GTT concept were carried out essentially in parallel. Also, these steps were initiated early in the task. The system requirements which establish what is to be trained in the GTT are derived basically from the task descriptions compiled in Task One and the performance data produced in Task Two. More directly, these requirements are also derived from the so-called aggregated tasks that were produced in Task Three. These aggregated tasks are discussed in the third task report and elsewhere in this report. Briefly, for the purpose of this discussion, the aggregated task is a compilation of the detailed analysis results to produce a single performance statement concerning the same equipment and/or procedures within each section. For example, the use of the FIST Digital Message Devices (DMD) is an aggregated task from the several mission-specific uses of the DMD shown in the

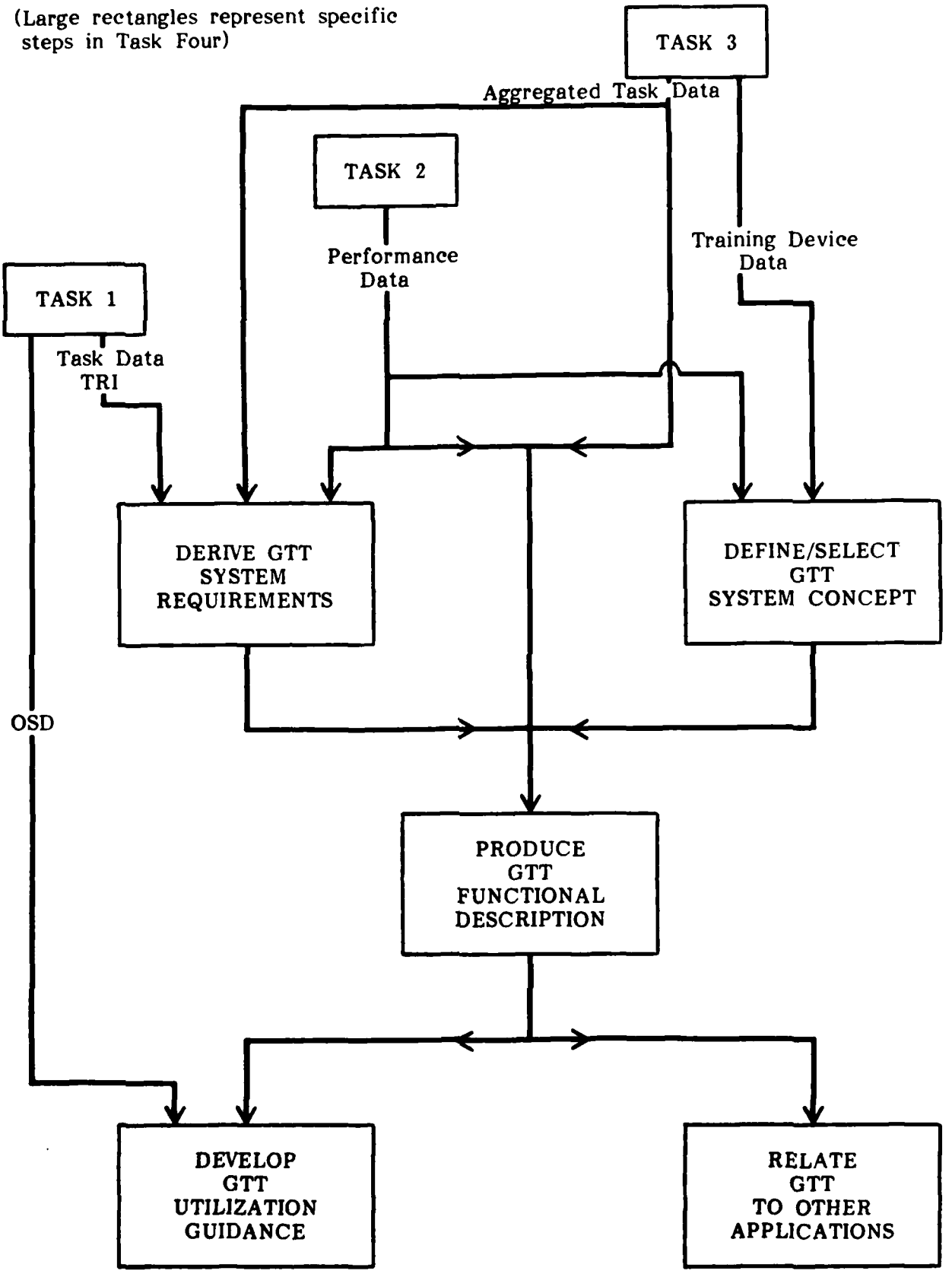

Figure 2. Flow Diagram of Task Four

analysis. This aggregated task then becomes a requirement for training. Throughout the earlier analysis the several specific applications of the DMD were considered at each analytical level. In that way, the required performance and performance measures were readily identified and confirmed. Now, in dealing with a system for training, it is more efficient to think about the broader statement of the need for training the use of the DMD. The context of a specific mission application is introduced by the way in which the GTT is used (see Section VII, Utilization). The training requirement is simply to train FIST personnel to use the DMD at levels of performance derived from the analysis results (e.g., the most demanding levels of speed and accuracy or some representative levels).

In effect, then, the aggregated tasks become the basic training requirements of the GTT. The GTT system must, to illustrate, train FIST personnel to use the FIST DMD to prepare, transmit and receive fire mission messages. The specific information about conditions of performance and performance measures is derived from the task data and IPO data generated in the first two program tasks. But, at the level of a system requirement, the aggregated tasks serve to help establish the system functional description. It is noted in Figure 2 that the Training Requirements Index or TRI is an input to the derivation of system requirements. While this is true, the TRI has not proven to be as potent or as useful as the original concept of the index suggested. There is a discussion of the TRI in Section VIII of this report. In the context of setting system requirements, the TRI only indicates that each of the aggregated tasks merits training resource expenditure. The differential rate of expenditure among the several tasks is not indicated decisively by the TRI. In fact, such differences can be established through a consideration of the essential characteristics of each aggregated task: fixed vs. variable, cognitive vs. motor, etc. The relationship of these characteristics to the GTT system concept is discussed in Section IV, GTT System Concept, under the heading of Trainee Interface.

2. Defining a System Concept

The process of defining or selecting a training system concept involves an understanding of the training process, itself, as well as the integration of analytical data as shown in Figure 2. The definition of the GTT concept began very early in the program and progressed iteratively to the concept that is presented in this report. The inherent characteristics of a gunnery team training system were identified in general terms at the outset of the program and were established more precisely as the program progressed. These characteristics were then examined from the viewpoint of good training practices and the state of training technology so that a set of appropriate, essential characteristics was developed. These concern such issues as the use of simulation, fidelity of simulation, performance measurement, etc. Next, these characteristics were reviewed as to the underlying purposes of controlling training resource expenditures and conserving resources. Finally, the analysis results concerning gunnery team tasks and training device/simulation assessment were combined with the essential system characteristics to evolve an approach or concept for the GTT. The concept was then represented and described as a set of equipment and procedures that, when implemented, would provide effective gunnery team training.

3. Producing a Functional Description

The functional description is essentially a Type A Specification that describes what the GTT is intended to train and what are its functions. This description is a compilation and presentation of all of the functions to be performed by each GTT component identified in the concept. This "A Spec" provides the basis for engineering development and production of a GTT but is, itself, only a functional description. Because the concept includes currently operational equipment as well as adaptations of existing or emerging Field Artillery training devices, part of the functional description represents existing equipment and procedures. The Firing Battery Trainer (FBT) is an example of existing equipment included within the concept. Other components, such as the Forward Observer simulator, are at only a conceptual level.

4. Developing Utilization Guidance

This part of Task Four represents essentially a translation of established unit training procedures and needs into the GTT concept of a performance-based system of training making use of simulation. In a sense, the utilization guidance developed here is a reflection of the traditional Army approach to unit training and readiness assessment that is contained in the Army Readiness and Training Evaluation Program manuals (ARTEP). The process of developing utilization guidance was directed toward providing an overall framework of GTT use within which the person responsible for a unit's training can develop a specific program to meet that unit's needs. There is no intent to preempt the role of the trainer (instructor) in planning and conducting training that is tailored to the status and needs of the unit. It is, in fact, intended that the guidance given here will facilitate the "tailoring" process and encourage the responsible person to perform that vital process with even more diligence than might now be applied.

5. Identifying Other Applications

The focus of this entire program has been on unit training with simulation to control resource expenditures. The system that has emerged, the Gunnery Team Trainer, can perform that role effectively. The GTT, since it will identify and collect a large amount of performance data, can be thought of as a data collection medium. Thus, the GTT could serve other research and development applications that make use of such data. Also, the performance-based approach to training can be applied in other settings. The GTT is intended to reduce the need for live-firing but firing exercises (FTX) will continue to be held and parts of the GTT can be employed to score and record FTX performance. The possible extended applications are presented in Section VIII, Discussion.

IV. GTT SYSTEM CONCEPT

A. Selection of a System Concept

The essential objective of the many activities within this research program has been the development of a description of a system for training the gunnery team at the unit-level in the skills and tasks that make up the target engagement process. Such a description is intended to be useful in itself as a basis for implementing unit training for the baseline and closely similar cannon systems. In addition, it is intended to serve as a model for any artillery training system. Finally, it will serve to illustrate the analytical techniques that were used for possible application to other Field Artillery activities concerned with Soldiers Tasks or with system development. This section of the report describes the selection of a concept for the training system and describes the system at a functional specification level.

Virtually all of the program activities to this point have been devoted to the analysis of the baseline system and the development of training implications for the training system. The concentration of these activities has been very largely on training content: what are the processes to be trained, what performance should be obtained, how can that be measured and what are the training-relevant characteristics of the tasks and processes. The analyses have, in other words, produced the information from which training objectives can be created. These analyses, as has been noted earlier, followed traditional training development practices. The outcome is a statement of what is to be trained. In order, however, to produce a description of a system for training, it is necessary to determine how that content is to be trained. The issue of how to implement the required training must be addressed. To define the implementation requires that several other factors be considered. The factors that relate to training device and simulation feasibility and appropriateness are probably the most important for this program. But, one other important factor to be considered, even though it has not been explicitly articulated in this program, has to do with the purpose of the training system. Because a statement of purpose sets a context for considering all other factors, it will be discussed first.

1. Purpose of the Training System

The essential purpose of this system is to develop and improve the skills, knowledge and attitudes necessary for the successful performance of the gunnery team in target engagement. The system is to function at the unit level and is concerned with the integrated performance of the team as it will function in combat. Every aspect of this purpose has some effect on the selection of a training system concept or approach. Each of these will be considered below, but, first, consideration must be given to the fact that this is a system for training. The significance of that fact is that to accomplish training a system must provide effective media or presentation, it must define the behavioral outcomes of training in terms of operational performance and it must provide a context for the instructor-trainee transactions that will facilitate and enhance the learning process.

These comments are made here to establish the need for giving attention to training technology in the specification of this system. Very often, it appears, processes and equipment have been designated as training systems or devices when all that they provide is a means for rehearsal or practice. In an earlier part of the program, the current inventory of FA training devices was reviewed. These devices shared the characteristic of providing practice with little or no provision for measuring and evaluating performance. One notable exception among current devices and approaches is the Closed Loop Training Concept. That concept includes the means for the gunnery team to practice a complete mission, but most importantly there is a definition and measurement of certain performance elements. The inclusion of the Firing Battery Trainer (FBT) in that concept indicates the development of a training system. The FBT measures and records elements of the Howitzer Section's performance, thereby implementing the critical training functions of diagnosis and evaluation.

This concern for performance definition and measurement is reflected in the GTT concept. The performance elements are defined in the analysis results on which the GTT concept is based. Further, the GTT includes a processor as a means for collecting actual trainee performance data and comparing that to the required or ordered performance. For example, the azimuth and deflection as set into the howitzer will be sensed and compared to the values in the gun order. In implementation, the "processor" function may be accomplished by automatic or manual means or by some combination. The exact means will be determined by many factors, such as feasibility and cost of direct sensing, rate and frequency at which data will be obtained and the utility of the data for immediate feedback. Conceptually, it is sufficient to establish the need for a "processor" function.

Finally, as regards performance, the GTT concept provides for the presentation of performance data to instructors who are responsible for the conduct of training. How this is implemented also depends on factors such as those noted above. The GTT must provide for the performance data to be available for use directly in training or in subsequent evaluation. (The issue of where data are used in the training process is addressed further in Section VII, Utilization.) The GTT concept also includes provision for recording performance data not only for crew training, but for evaluation and possible revision of the GTT, itself.

In summary, the GTT concept is strongly performance-oriented. The training objectives will be performance-based, and performance measures and criteria will be used in the conduct and evaluation of training. A combination of operational equipment and simulations has been determined to be the most appropriate training medium. This medium also allows for reasonable conservation and control of training resource expenditure. These attributes identify the GTT as a system for training. There is an additional characteristic defined in the GTT purpose that affects its training use: it is intended to be used in unit-level training. This is defined as training accomplished by an operational unit to maintain proficiency and readiness in its assigned mission. The implications of this are:

- Trainees, i.e., the gunnery team are qualified in their own MOS.

- o The system/equipment must be suitable for/accessible to use in garrison.

- o Individual task training is not a primary function of the system, but it should be feasible.

The fact that the GTT is a system for training, one in which skill and knowledge levels can be sustained and increased, is basic and critical to the definition of a system concept. There are, however, a number of other considerations that shape the GTT concept. The next one to be discussed has to do with Training Fidelity or realism in training.

2. Training Fidelity

To begin, the issue of fidelity in training has to do with the amount of realism that is introduced into a training system. Flight simulators used in pilot training are highly realistic in presenting environmental and operational conditions. They offer a high degree of fidelity. For some training, such as automobile driving, training takes place under actual operating conditions and thus has virtually complete fidelity. There are two aspects of fidelity: the physical and the operational. The former which has to do with the representations of the environment and equipment and is relatively easy to conceptualize; physical simulation is often the goal in designing a training system because it is so easy to comprehend and usually can be achieved. Physical simulation, however, may not be necessary in training; simply mimicking the appearance, and perhaps some of the functions, does not insure that there will be positive transfer from such a "realistic" training system to the operational system. For training, the critical aspect of simulation is that it be operationally realistic. The training system must provide for the same human functions, the same inputs, processing and outputs, as required in the real system. When this is achieved, the probability of positive transfer is increased. So, in the specification of a training system, the basic concern regarding fidelity has to do with the operations that will be performed by the trainees. There must be realistic approximations of the required tasks, or the tasks themselves. In the proposed system, the gunnery crew will be required to perform their actual tasks, for the most part, but some--notably the observers' tasks--will be simulated.

In this discussion of fidelity, the focus has been on task training and the conclusion was reached that operational realism is the essential ingredient for such training. The role of total, physical simulation in the training process changes, however, with changes in the level of training. In general, as the skill level of the trainees advances, physical realism contributes more to the successful outcome of training. Once the requisite skills have been acquired, training emphasis is on the application of the skills in an operational setting. This aspect of realism is noted in a military human engineering handbook (5) Chapter 14. Also, in a review of literature performed by ARI (6), it is noted that in team training it is desirable to "learn by doing in a combat-like environment" (p. 310). The team members having been trained in the individual tasks need to learn the team activities in a realistic environment. Along with skill level, the value of realism changes with the amount of group or team interaction. A high degree of physical realism appears to facilitate training in team or collective tasks more than in individual tasks. The above ARI review makes a conclusion that military teams should be trained in conditions that approximate those in which they will be expected to perform.

It should be noted that these indications of increased value of fidelity in more advanced and collective training may in part be artifactual. It has been observed that in early stages of training--when a skill is just being acquired, physical realism may be an interference in the learning process. This effect is suggested in a study of pilots learning to fly holding-patterns (7) where a computer-based procedural trainer led to more accurate patterns in a criterion flight than did actual flight training. It was suggested that the competing demands of instruments might interfere with learning the pattern flight procedures. If that interference with early skill training really exists, then it may be that for the more advanced skill levels (such as will be found in unit training of the gunnery team), there is simply no effect. Since it has not been a requirement of this program to do an extensive training literature review, clear evidence for or against this possible artifact cannot be adduced. It does appear, however, that the sense of the literature does support the positive benefit of realism for advanced and collective training. There is certainly no question that realism tends to increase motivation and is related to confident, positive attitudes about training results. One FA study (8) notes synthetic training was at least equal to training with real equipment when measured by live-firing results. However, there was greater self confidence and a more positive attitude expressed by the persons who trained with actual equipment, i.e., with complete realism. In addition, there is a large amount of literature--anecdotal as well as technical--attesting to the motivational effects of aircraft and other vehicle simulators. Perhaps of equal importance for this program to any of the above, is the fact that the Field Artillery has undertaken many training device and simulation studies and each of these has been marked by a strong concern for realism. It has been noted earlier that many of these devices are deficient from a training viewpoint in that performance definition and measurement is lacking. In spite of that, the attempt for realism marks these products as potentially valuable training tools and underscores the value of realism as already recognized by the artillery.

The GTT, therefore, is defined to strive for a high degree of realism in training. The use of operational equipment, in addition to satisfying the training media assessment noted in the previous section, provides a substantial degree of physical realism. Likewise, basing training on actual fire mission procedures adds to the operational realism. Environmental realism--physical or operational--is not systematically provided in the GTT. Some degree of realism for a range of physical environments can be achieved by scheduling the use of the trainer to encounter a variety of conditions. Operational realism--live fire, battle stress, etc.--is difficult to achieve and costly. It is judged to be inappropriate to attempt that degree of realism in unit training. Such realism can be experienced in live fire exercises in combined arms training.

The issue of fidelity in training must also be considered in terms of the potential that any synthetic means would have for training the gunnery team.

A study for the U.S. Navy (9) compared computer-based training (CBT) to traditional classroom and hands-on training of performance skills. The skills are those used by a co-pilot to operate an ASW system operational panel which includes a situation display, a track ball and variable function push buttons. The CBT provided a graphic representation of the panel that was programmed to respond interactively to the trainee's input and control. The

CBT was characterized as being high in operational fidelity, but low in appearance fidelity. Performance of the CBT trained and the traditionally trained subjects was measured on a high fidelity simulator used for co-pilot position training. The CBT group was faster and completed more tasks (in the simulator) than did the traditionally trained group. A similar finding occurred in an FA study already noted (8) which indicated equivalent performance between two groups of gunners: one having trained on actual equipment and one on a training device. A number of studies report similar findings. It must be observed, however, that most of these studies relate to skill training--often relatively simple skills--and they do not typically include team performance. There is, then, a basis for using a completely synthetic approach to skill training. However, there appears to be little justification for generalizing these results to gunnery team training.

The point of view that only actual live-firing can provide adequate training is one that has been expressed usually by operational personnel who might be considered "traditionalists." However, there is also support or at least partial support for this view in the training research literature. The ARI review noted earlier (6) suggests that training must be performed under realistic combat conditions which implies the use of operational equipment. A number of studies report improved trainee attitude or confidence as a result of using operational equipment in training. Overall, there appears to be some support for the use of real equipment in realistic settings. For this program, however, the decision about using operational equipment for training hinges on two points other than specific training utility. First, the largest of the actual equipment in an artillery system, the howitzer and its support vehicles, would be difficult and expensive to represent in physical fidelity. So, unless it could be shown that part-task devices or some form of computer-based training could be used to implement unit training, the development of surrogates for the howitzer is judged impractical. Also, the possibility of establishing gunnery team training on part-task trainers or on CBT using graphic representations for performance tasks must be judged remote. This is only to say that given the present state of training technology and the analyzed needs of the artillery, the two mentioned approaches are not appropriate. It is clearly true that training technologies are developing in both capacity and sophistication and in the future this position might well be changed. The possible application should not be abandoned, it is just not appropriate now.

Extensive use of synthetic training is not indicated for the GTT at this time. The procedural, equipment-related tasks are most effectively trained (at the unit level) on the actual equipment. (A requirement for augmenting that equipment with performance-measuring devices is presented in Paragraph 4, below.) Further, the development of physical simulations of artillery hardware is judged to be too costly for practical implementation. In addition, the use of surrogates, such as a computer-based training approach, has not been shown to be appropriate for team training at the unit level. However, simulation is needed to represent the process and effects of live firing. Also, as will be discussed below, there is a special need for simulation to provide adequate observer training. In summary, simulation is needed to avoid the expenditure of resources in moving to remote, safe ranges and in firing full rounds. The further need for simulation of FIST/FO functions is presented next.

3. FIST/FO Considerations

A major emphasis of this program is on gunnery team training. The contractual description of the program refers to the integrated functions and tasks performed by the three subsystems, i.e., Howitzer Section, Fire Direction Center and the FIST including the FO. There is an impediment to such training in that the FIST and FO are attached to the supported maneuver unit and are not a part of the artillery battery. Thus, unit-level training of the whole team will require coordination between the artillery and the maneuver units.

Further, unit training will often be conducted at the battery level and may even involve single platoons. The importance of this is that in any given unit training exercise only a few observers will be required. This fact, combined with the emphasis on realism in unit training, suggests an observer component that can be operated in a field setting for two or, at most, a few observers. Such a facility could be emplaced at a realistically remote location from the FDC and howitzers. Since the GTT concept does not encompass live firing and because it will be advantageous to allow training in a variety of environments, the need for simulation of environment and targets for the observer is clearly established.

Simulation for the observer function is not an easy task. The observer's perceptual activities involve detecting, locating and identifying targets in natural terrain. The targets may be camouflaged and may be at ranges that result in very small, apparent images; they may be moving or stationary. If moving, they will take advantage of any cover to avoid detection. This is clearly a difficult task; yet it is critical to the success of a mission, for without this task the indirect artillery fire process cannot be started. Since it is assumed that the tool skills of map reading, searching for targets, detecting evasive or hidden targets, etc., will have been taught in MOS training, the job of unit training must be to maintain these skills and enhance them through exposure to increasingly difficult problems. The obvious conclusion from the above is that the GTT concept must include simulation of terrain and targets that has extremely high fidelity and allows for precise registration among the target, the terrain and the impact.

The observer function includes a further cognitive activity in which the target is identified and located relative to a map and/or a target list. The effect of this on the concept of an observer simulator is to emphasize the need for precision and accuracy of representation. This will provide the basis for accurate evaluation of the total observer job. At the present time, the observer function in the team context is addressed by only one Field Artillery Device: the Training Set Forward Observer (TSFO). It serves both as an entry-level trainer in the Field Artillery school and as a unit-level trainer in the Closed Loop Training Concept (CLTC). While the TSFO has been judged to provide "fair" to "good" training of the observer function in Task Three of this program (3), it does have shortcomings when looked at as a component in a realistic team training system. In its present configuration, it is a school-type trainer accommodating up to 30 observer-trainees in a permanent building. It does not provide for environmental exposure (of the observer). The TSFO targets--in the judgment of subject matter experts at Fort Sill--are not at all realistic: they appear as white silhouettes. The system for gunnery team

training must be defined to include a simulation that provides a realistic setting for the observer function including environmental features as well as realistic representations of targets and impact effects. The GTT will attempt to provide for observer performance in an environment as might be encountered in actual operations. This part of the GTT may be similar in concept to the Guard Fist II which is a device in conceptual development by the National Guard Bureau with USAFAS support. The observer component, in summary, will provide a compact yet accurate and precise presentation of physical environments and targets. It will, if possible, function in a field setting and will permit the connection among the sensors and processes in the GTT. It will provide performance measurement relative to the simulated target position and other characteristics. The measurement of performance as it relates to the GTT is discussed next.

4. Performance Measurement

Training is a process in which a trainee achieves the skill and knowledge needed to perform a job in a specified way. Training, therefore, should be defined in terms of performance-based objectives. In this program, the analysis of input-process-output (IPO) of each baseline system task identified the expected job performance as well as the means for measuring (observing) it. This program thereby created a data base from which appropriate, performance-based training objectives can be derived.

These statements about the role of performance definition and measurement in training might appear to be statements of the obvious, but practical experience as well as systematic research indicate otherwise. Training media and even systems of training are frequently developed to provide some facility for training without explicit information about what is to be trained. For example, a mock-up or simulation of a piece of equipment might be produced as a training aid or device yet not be documented as to the behavior that the trainee should learn or how it can be observed (measured) or what constitutes desired performance. In an earlier part of this program, the Field Artillery training devices that were reviewed seemed designed to allow practice but with little, if any, definition of the task to be learned or of how to measure the success of training. It is not an overstatement to say that the definition and measurement of performance is a principal basis, if not the single most important one, for developing a training system. In the GTT, there will be provision for measurement of performance within each task as well as of the team performance.

The value of measurement in training is enhanced when the performance data are available for prompt feedback to the trainee. In the ARI literature review already cited (6), it is noted as one major recommendation for team training: "Team members should receive performance feedback." (p. 311) The discussion of this finding goes on to say that the feedback should be in terms of the required team and individual performance. To increase the value of measurement still more, it would be desirable to provide feedback automatically during the training process as well as in debriefing after training. The GTT will provide for in-process feedback, to the extent feasible, and will record measures for instructor debriefing following an exercise.

During the course of this program, there have been questions raised about the utility in unit training of the identified performance measures. There

are apparently two concerns: first, that the measures are too finely divided and, second, that the only measure of interest is impact on the target. The first issue can be illustrated by the task, "Set/Lay the Howitzer for Quadrant (RQ)." In the IPO analysis, that task was segmented into 11 elements and a performance criterion was identified for each element. Unquestionably, this amount of detail exceeds practical application in a team training situation. Unit-level training, however, must also accommodate remedial and cross-training in both of which there is a need for the details of performance. In the proposed system concept, provision will be made for a combination of detailed and inclusive measures.

The second comment made about performance measures which suggests that only the ultimate measure of "did hit" is important appears to be made outside the context of training. There is validity in the idea that what really counts is to hit the target, but to develop a team that can do that repeatedly with good reliability, each member of the team must be trained and evaluated in the details of each of his tasks which requires the fine-grained measures. Also, the team performance must be evaluated at the section level to diagnose both training needs and training success. Again, measures at a lower level than the all encompassing "did hit" are needed. The GTT concept includes both individual and section performance measures. Some of the higher level measures, including the ultimate effect on target, suggests a concern for readiness assessment. Because the GTT will include these measures, it may be considered to have an application as a readiness-measuring device. Such additional uses of the GTT are noted in the next section.

5. Other Applications

The immediately obvious additional application of the gunnery team training system is in readiness assessment, which is effectively an outcome of the training process. It is in part for this potential use that training sequences based on actual fire missions have been proposed. These sequences (which have been documented in operational sequence diagrams) do represent the ultimate goal of gunnery team training but they also represent sequences that are critical for readiness assessment in the ARTEP (10). The ARTEP manual describes five mission sequences for which readiness should be demonstrated. The proposed training sequences consist of two Adjust Fire Missions--autonomous and non-autonomous; the Precision Registration Mission; a Fire for Effect Mission; and a Copperhead Mission. These five sequences encompass all of the fire mission tasks and procedures associated with the baseline system. Thus, there is a sound basis for defining a readiness role for the GTT.

The second possible application of the GTT is as a research vehicle. The technology underlying the Field Artillery continues to grow with improvements in data processing and communication and with improvements and innovations in ammunition and in delivery techniques. Throughout this growth and change, the presence of human operators will be continued. The role of the artilleryman in new or modified weapon systems and the measurement of performance are two areas that would be well served by a system that provides a research base for the manipulation and measurement of crew activity. Even for current systems, the effects of training, selection, crew composition, etc., could be examined with the proposed system as a research tool. This issue is addressed more fully in a later section of this report.

The above completes the presentation of factors beyond the analytical results that have been considered in the development of a concept for the gunnery team training system. The process of integrating all of these factors into a concept definition is not a single discrete step, but has taken place throughout the program. It has been an iterative process of combining the system purpose, the training content and the review of devices into a structure that is responsive to the original goals of:

- o Unit training effectiveness
- o Resource expense containment
- o Systematic derivation of training needs

In the following section of this report, the GTT concept is described.

B. GTT System Concept

1. Overview

Figure 3 is a functional block diagram of the GTT. Three of the basic, most significant facets of the system concept can readily be seen in that diagram:

- o The trainee interface with GTT is accomplished through operational equipment.
- o Currently available and emerging Field Artillery training devices are the basis for the required simulations.
- o The function flow represents an integration of all team members.

Each of these is discussed below.

a. Trainee Interface

In general, the interface between GTT and each member of the gunnery team is through the operational equipment normally used by the trainee. The exceptions to this are that the Howitzer Section will use a shootable practice round with simulated recoil and the observers will use a video presentation of terrain, targets and impacts. Further, the implementation of the observer simulator may require some special tools or techniques for viewing, such as binoculars with specially scaled optics. However carefully that kind of adaptation is designed, the observer will not be performing in a totally realistic way.

The rationale for structuring the GTT around operational equipment includes two considerations. First, because the tasks in the Howitzer Section and in the FDC are largely "fixed," that is, tasks that reflect a procedure for equipment operation, they are most efficiently trained using

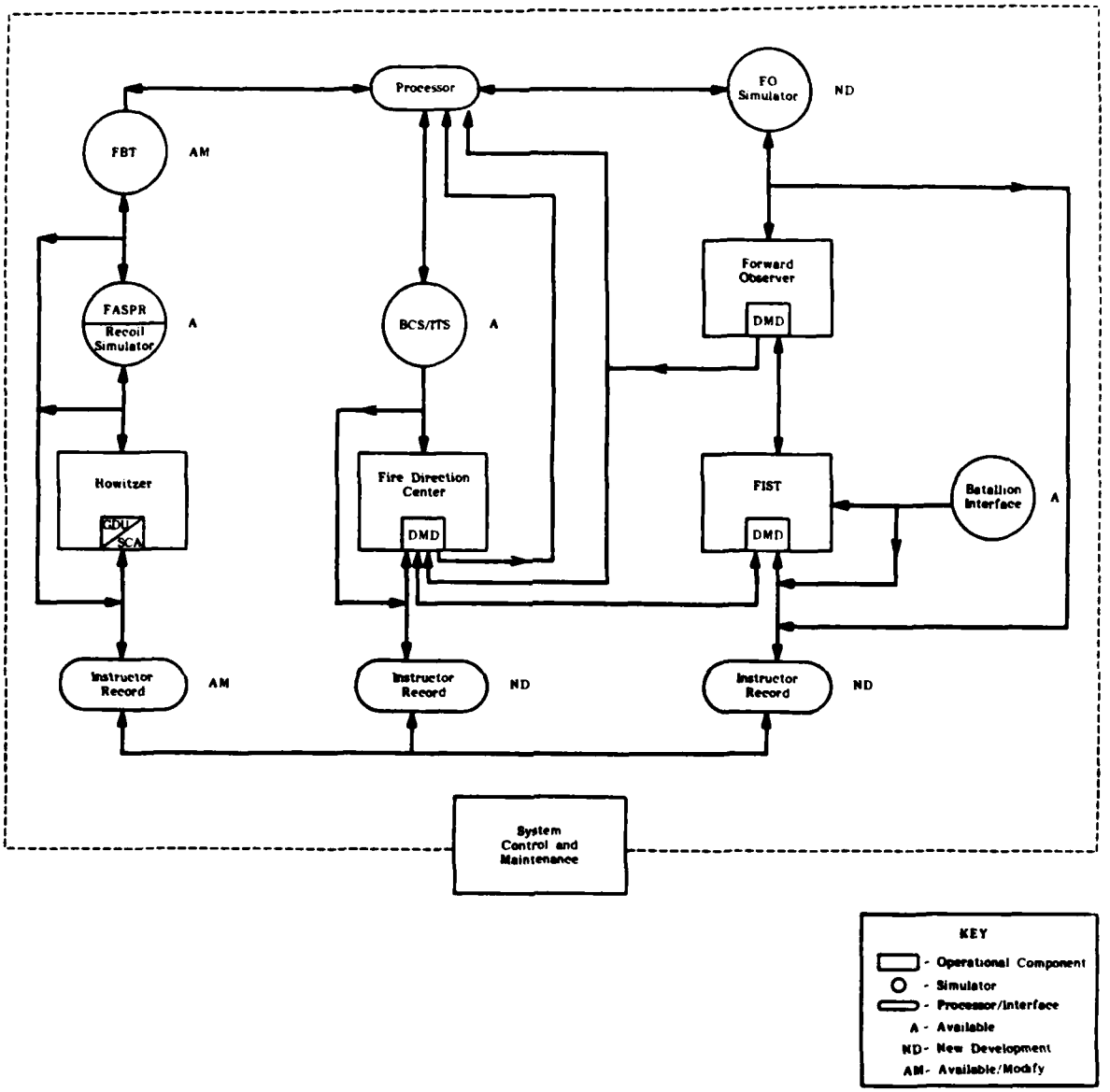

Figure 3. GTT Functional Block Diagram

actual equipment.* Not only is this approach consonant with good training practices, it also follows the results of the assessment of training media done earlier in this study based on the practical experience of the program staff. Finally, as regards these procedural or fixed tasks, the use of operational equipment coincides with a widely held attitude in the Artillery that favors "hands-on" training. While this attitude cannot be validly generalized to all training, it is certainly valid for the gunnery team.

The second basis for using operational equipment is closely allied to the first. It is that operational equipment provides a high degree of realism. Because it is team training and because it is for sustainment of proficiency, the GTT is made more effective through realism. (See preceding discussion of Fidelity, p. 19.) Because the GTT concept includes a shootable practice round with a limited range (about 200 meters), it is expected that a safe firing area can be readily located on almost any facility housing an artillery unit. Therefore, it is judged that operating costs, primarily fuel, projectile and propellant, will be at a minimum. The value of the realistic, hands-on training will prove to be worth such operating costs.

b. Existing/Planned Devices

Figure 3 shows the application of five devices that are currently in the Field Artillery inventory or are under development. In the Howitzer Section, the GTT concept includes the Firing Battery Trainer (FBT), the Field Artillery Shootable Practice Round (FASPR) and the Recoil Simulator. None of these is yet fully fielded, but all have been demonstrated and contribute to the objectives of the GTT. The FBT provides the means of detecting and measuring performance at the howitzer. It also provides for transmitting and recording performance. This implements the required measurement and feedback (short- and long-term) of trainee performance. The FASPR and the Recoil Simulator provide for a high degree of realism in munitions handling and firing. The FASPR, however, is propelled no more than 200 meters down range and is recoverable and reusable. Thus, the desired realism is achieved with only limited munitions cost and very modest space requirements.

There is indicated in the GTT a Forward Observer (FO) simulator that is defined functionally to provide terrain, target and burst representations for the FO. This combines elements of the current Training Set Forward Observer (TSFO) and its link to the FBT with elements of the Guard Fist II. The critical features to be provided by these devices are fidelity of representation (through the Guard Fist II video concept) and the determination of burst location as provided by the FBT/TSFO link. The concept includes two input sources that appear to be required for the GTT to function as described. One is at the FDC and is defined as a means of providing digital input to the BCS. This appears to be an adaptation of the current BCS Interface Training

*It should be remembered that what is addressed here is unit training to maintain and improve proficiency. The basic proficiency will have been achieved in school training leading to the award of an MOS. At that basic level, surrogate devices and procedures may be useful to attain proficiency. For the unit level, actual equipment is a more effective medium.

Simulator. A similar adaptation appears to be required at the Fire Support Team (FIST) to represent battalion/maneuver unit input to the FIST.

The essential reason for incorporating these devices is one of economy or conservation. This program began at a time when many of these Field Artillery devices and concepts had advanced to actual testing and field use or were at least well defined and well thought-out concepts. To overlook these developments and propose new but similar approaches would at best be wasteful. Perhaps the most significant reason for incorporating these devices is that they each represent an Artillery solution to an Artillery problem which generates confidence that they are both usable and effective. The training technology deficiencies noted earlier in this program (lack of performance definition and measurement, mostly) are overcome in the incorporation into the GTT.

c. Integrated Performance

The GTT concept is based on the premise that the training to be accomplished is that of the integrated performance of the gunnery team. The functional block diagram illustrates this in the flow of information depicted among the three parts of the team. This is not only in response to the statement of work which stipulates "integrated team activity." Is is, more importantly, in response to the definition of the team, itself, which (briefly) is that the team performs all of the functions required to complete an indirect fire mission. To do that requires the mutual working together of the three subsystems and the flow of target information from the observer (or other source) through the FDC to the howitzer and finally the flow of similar impact information: observer to FDC to howitzer. What is referred to here as integrated performance is quite similar to the Closed Loop Training Concept (CLTC) that has been demonstrated by the USAFAS and the U.S. Army Human Engineering Laboratory (HEL). The differences or similarities between the two approaches need not be emphasized. Both approaches implement the complete circuit of information beginning with target acquisition and proceeding through technical fire direction, firing, impact evaluation, and adjustment. The GTT approach is focused on performance-based training requirements and measurement and is especially adapted to unit training. Those features represent the objectives set forth for the GTT and they have been met in this concept.

2. System Control, Management and Maintenance

The GTT concept attempts to establish a trainer that is fully responsive to the requirements of training technology and the needs of the unit. To that end, the concept includes provision for up to three trainers--instructors--each of whom is responsible for one subsystem. These instructors control the GTT, and take part in its management. There are a few aspects of this that merit further consideration.

The GTT is intended for training and since it is not a self-instructional medium or an automatic one, instructors are needed. These instructors will be expected to meet traditional Army requirements. That is, that they are subject matter experts (SMEs) with regard to the subsystem for which they are responsible, and they will be qualified as instructors. Importantly, for unit training it is expected that the instructors will not be

performing that function in addition to being part of the team. It is suggested in some Army literature that a Section Chief will be responsible for training while performing as chief. This detracts from both jobs and certainly limits the effectiveness of feedback, diagnosis and training supervision. These critical functions can only be performed by someone who is skilled in Army training and devotes full time to training duties for the duration of an exercise or drill. This is not to be taken as a requirement for the addition of an instructor position to each unit's complement. What is suggested is that personnel in each unit who are qualified in the Army training program be available for this training duty. The ARTEP manuals, for example the one applicable to the baseline system (10), state that the "leaders" shall be responsible for training the soldiers for whom they are responsible. Also, the manuals specify the commander's responsibility to plan for and provide training, including qualified trainers as one necessary resource. These principles are further elaborated in the series of Army Field Manual devoted to training (FM 25-1 through 4). Specific guidance for instructor preparation at the unit level is contained in FM 25-3.

As indicated in the Functional Block Diagram, the instructor control and management of the GTT will be implemented in three parts--one for each subsystem. This concept is not meant to imply the requirement for three physically distinct components. It may be implemented with a single instructor station to which will be transmitted the performance data compiled separately for each subsystem. The essential concept here is that qualified instructor control is needed and that data will be segregated by subsystem. The precise nature of implementing this must be determined in subsequent development.

There is a higher level of system control contained in the GTT concept. As a unit-level trainer, the GTT must allow for "tailoring" the content of training to the unit's needs. Basically, this requires that the GTT reflect the mission and the location of the unit. It is anticipated that this will be achieved by loading a number of parameters into the system uniquely for each unit. The most obvious, and perhaps most important, of these is terrain depiction. The Forward Observer Simulator will be loaded with appropriately designed discs (or other video input) to show the terrain in which the unit is located and/or will operate. Along with this, an appropriate set of targets (and tracks, for moving targets) will be loaded into the Processor and Forward Observer Simulator. Also, appropriate ammunition and ballistic data will be generated and loaded for use in the Battery Computer System (BCS) and in the GTT Processor. The Processor uses that information to generate impact data and input that to the Forward Observer Simulator.

One final aspect of management and control has to do with what has been designated "system maintenance." This concept is that the system, GTT, will compile performance continuously to provide a quantification of its application and its success. The performance data will be the same as or a summary of the performance data used in the training process. For system maintenance, however, the data will be used to evaluate GTT effectiveness: how much does team performance improve as a consequence of training? The data will likewise provide a basis for the analysis of GTT architecture by helping to assess the contribution of each part of the system to overall effectiveness. As presently thought of, the System Control and Maintenance

component will likely be implemented as a manual function supported by appropriate processor routines and outputs. The management and maintenance functions are not seen now as automatic or self-regulating.

In summary, the GTT concept envisages a system for training that is based on a high degree of realism in team training which is performance-based. To these ends, operational equipment is to be used, and operational fire mission procedures and tasks are to be the basis for training. Simulation is proposed to provide a realistic observer setting without deploying to field locations; reusable practice rounds permit the exercise of realistic howitzer procedures with a minimum expenditure of resources for moving to and setting upon a full firing range. Effective system control and management is provided through a combined manual/processor function. That latter function also provides for the monitoring, evaluation and refinement of the system. This concept allows for possible application of the GTT to other kinds of training as well as to research uses.

The specific system requirements, i.e., what the GTT is to train, are presented in the next section. A functional description of the GTT is presented in Section VI, and in Section VIII other possible applications of the GTT are presented.

V. GTT SYSTEM REQUIREMENTS

A. Introduction

In Section IV, the GTT concept of a unit-level trainer, with operational interfaces among the FO/FIST, FDC and Howitzer Sections has been defined. The observer transmits fire orders; the direction center provides technical fire direction; the howitzer executes the ordered mission; and the observer monitors the effort and provides corrections. Both practice and diagnostic evaluation are called for in this concept.

Next, a summary of the specific system requirements is needed in preparation for defining functional specifications for the GTT. These system requirements are the basic definition of what it is the GTT will train. They are broad statements of the behavior or performance that the team members will exhibit after successfully completing training. The system requirements are a form of training objective, but at a less detailed level than that at which objectives are traditionally stated. In this program the details of tasks to be trained, performance measures, criteria, etc., were developed in a set of thoroughgoing analyses. At the completion of that effort, all of the results were examined to identify team performance in a compact set of statements. Because the same gunnery team equipment and procedures are used in many operational settings, the analysis showed much repetition and redundancy. That duplication of information was removed and broader performance statements were compiled. Each is unique to a gunnery team section, to an equipment and to an operator procedure. These have been designated as "aggregated tasks." It was during Task Three of this program that these were developed and were then used in the assessment of training technology. A summary of the results of Task Three is attached to this report in Appendix C. Those summary tables should be referenced in connection with the following statement of GTT system requirements.

Before proceeding to the requirements, themselves, it is essential to remember that the GTT is a unit-level system and to be aware of the impact of this on system requirements. The statements of requirements say that the team will "use a piece of equipment to (for example) communicate." That format, while descriptive of the task, could be interpreted to mean that training from entry-level to a stated proficiency is the objective. In unit-level training, however, it is the case that the team is MOS-qualified and that the basic skills have already been achieved. What unit-level training does is to sustain and improve each basic skill and employ it in a team setting. Thus, while each requirement is, for convenience and understanding, stated as a basic task, the important implication is that unit training is for sustainment and for the integrated training of the team.

B. Requirements

The requirements are presented below, grouped separately for each section of the team. Reference is made to the location of the summary tables in Appendix C.

1. FO/FIST Requirements

The aggregated FO/FIST Section tasks are summarized in Table 1 in Appendix C. There are six of these tasks to be trained in the team setting:

a. Using the DMD and FIST DMD to prepare, transmit, receive and forward messages related to all fire missions.

b. Using the GLLD to measure range and to illuminate targets; using on stationary or moving targets; using in daylight or nighttime operations.

c. Using the LRF to measure range.

d. Using visual/manual devices (map, plotting equipment, binoculars, compass) for: determining object location, altitude; recording data; drawing and using terrain sketch.

e. Decision-making related to all fire missions, including: a) target detection, identification, classification, threat assessment and location relative to zone of responsibility; b) target selection, based on threats, priorities and commander's guidance; c) command fire to engage selected target (fire, adjust fire data); d) evaluate mission to determine call for further adjustment or EOM; and e) safe operating procedures.

f. Timely operation under stated environmental conditions.

Regarding Task 1, the GTT should help train FO/FIST Section personnel in using DMD and FIST DMD communications to help carry out fire mission activities, including: request and adjust fire (indirect, area, suppressive, immediate suppressive, fire-for-effect, assault, destruct, illumination, smoke, creeping fire, final protective fire, irregularly shaped target, adjust by sound); receive messages for and report after determining direction and distance (registration points, targets including Copperhead, bursts, cloud height, impact and time registration); and control/coordinate FOs for conducting registration. Regarding Task 2, the GTT should help train the use of the G/VLLD to lase targets (moving and stationary under clear and limited visibility), to locate targets and bursts (high burst, request/adjust fire, cloud height; using grid, polar, known point methods), to designate targets during Copperhead engagements, and to conduct impact and time registration. Regarding Task 3, the GTT should help train the use of the LRF under normal and unusual conditions to measure range for cloud height, target location (grid or polar methods), to request/adjust fire (area, suppressive, immediate suppressive, fire-for-effect, destruct, assault, creeping, final protection fire, irregularly shaped target, smoke), to determine own location, and to conduct impact and time registration. Regarding Task 4, the GTT should help train FO/FIST personnel in using maps, plotting equipment, binoculars and compass to determine and record object locations (select target to be lased, select registration point, request/adjust fire, own location; using grid, polar, known point methods), to make a terrain sketch, to conduct impact and time registration, and to control/coordinate FOs for conducting registration. Regarding Task 5, the GTT should help train FO/FIST personnel in timely,

proper and safety-observant decision-making related to object assessment (targets, clouds, bursts, registration points), target selection for engagement (stationary and moving targets in clear and limited visibility conditions; for conventional and laser guided munitions), preparing fire commands (request/adjust fire) and the conduct of impact and time registration. Finally, Task 6 requires that all of the above activities be trained under the extreme environmental and operational constraints that may be encountered in wartime.

2. FDC Requirements

The aggregated FDC Section tasks are summarized in Table 2 of Appendix C. There are four of these tasks to be trained in the team setting:

a. Using BCS to process and evaluate RFAF (Autonomous) messages related to adjust fire, fire-for-effect, quick fire and Copperhead (target-of-opportunity) missions.

b. Using BCS to process TACFIRE messages related to adjust fire, fire-for-effect, time on target and specified fire plan missions.

c. Plotting/replotting targets on map, using BCS to receive and transmit related data.

d. Timely operation under stated environmental conditions.

Regarding Task 1, the GTT should be employed to train FDC personnel in using the BCS for processing FO/FIST messages, for determining fire data (grid, polar, known point, specific shell/fuze, quick fire, illumination and Copperhead) and for deceiving the enemy. Regarding Task 2, the GTT should train them in using the BCS for processing TACFIRE fire plans, for determining fire data (grid, polar, known point, specific shell/fuze, time-on-target, and illumination) and for deceiving the enemy. Regarding Task 3, FDC personnel should be trained in plotting/announcing chart data, replotting targets, and using tactics to deceive the enemy, all with the aid of BCS communications. Finally, Task 4 requires that all of the above activities be trained under the extreme environmental and operational constraints that may be encountered in wartime.

3. Howitzer Requirements

The aggregated Howitzer Section tasks are summarized in Table 3 of Appendix C. There are five of these to be trained in the team setting:

a. Using GDU/SCA and/or voice to receive, announce and repeat communications related to all fire missions.

b. Initiating, observing, evaluating and correcting operating procedures/conditions to insure safe handling and firing of the howitzer and ammunition.

c. Aiming the howitzer in elevation and deflection, using the elevation quadrant/range quadrant/direct fire scope and the pantel/collimator, respectively.

d. Loading, firing and clearing the howitzer.

e. Timely operation under stated environmental conditions.

Regarding Task 1, the GTT should be used to train Howitzer Section personnel in using the GDU/SCA and voice communications to help carry out fire mission activities, including: prepare ammunition; set/lay for deflection; determine that the howitzer is safe to fire; set/lay quadrant (both Gunner's Quadrant and Range Quadrant); and load the howitzer. Regarding Task 2, it should help train the procedures and activities for insuring that the howitzer is safe to fire, including: prepare ammunition; identify/correct hazards and settings; load the howitzer; and take immediate corrective action for a misfire. Regarding Task 3, the GTT should help train the Howitzer Section in aiming procedures and activities, including: set/lay for deflection; and set/lay quadrant (using both the Gunner's Quadrant and Range Quadrant). Regarding Task 4, the GTT should help train the loading, firing and clearing activities, including: prepare ammunition; operate the howitzer loading and breech mechanism; fire safely as directed; and post-fire swab and clear the howitzer. Last, Task 5 requires that all of the above activities be trained under the extreme environmental and operational constraints that may be encountered in wartime.

The above summary of specific system training requirements is supplemented by other needs derived from the various analyses conducted during this program. Those needs, which have been accounted for earlier in this document, are: 1) to recognize psychological (motivational), sociological and political factors that can influence if and how the training system is used; 2) to overcome past tendencies to concentrate on the practice component and ignore the diagnostic evaluation/correction component of training; 3) to overcome past tendencies to develop training technologies that focus on isolated tasks of a single individual or Section, to the exclusion of interactive tasks involving the entire gunnery team; 4) to overcome inadequacies of typical training effectiveness measures and cost measures; 5) to provide more effective FO training in the tasks of detecting, locating, identifying and classifying targets under realistic wartime conditions (despite the commendable capabilities of the Training Set Fire Observation); and 6) to take advantage of other research findings that have significant implications for the initial acquisition and long-term retention of skills or knowledge.

The GTT System Concept and Requirements are next synthesized into a functional description that can be the basis for engineering design and development.

VI. GTT FUNCTIONAL DESCRIPTION

A. Introduction

The GTT concept is defined to provide effective training with reasonably low expenditure of resources. It establishes the system as being strongly performance-based and using operational equipment together with simulations that are practically immediately available. Realism is stressed through the use of actual fire mission procedures in training. Those procedures also implement the major unit-training purpose which is to exercise and perfect operational skills and procedures. Within this concept, the GTT must meet 15 specific system requirements. These are statements of the performance that the gunnery team must be able to demonstrate as a consequence of training.

To fulfill the requirements and the concept, it is proposed that the GTT will use a synthetic physical environment, including synthetic representation of targets. These will be inserted into the system by means of the observer simulator. In lieu of live firing, the howitzer will load and fire a practice round having a very restricted range. This will be supplemented, for realism, with a recoil simulator. The use of these simulations requires the development and use of synthetic ballistic and firing data. These data will be entered into the system through its Processor; the BCS Interface Training Simulator may also be used with the Processor.

With these simulations and synthetic data using actual communication equipment and links, it is possible to control the GTT in a realistic duplication of actual fire missions. In other words, the GTT will emulate a real fire mission. The complete fulfillment of training, however, requires two more capabilities: the GTT--through its processor--must calculate from the synthetic firing data the location of the impact (or burst) relative to the target and environment synthesized in the observer simulator. The second capability is to sense measures or indicators of performance and compare (or facilitate comparison) to criteria.

The implementation of the GTT system concept and requirements, which have been reviewed briefly here, imposes a number of functions to be included in the development of an actual GTT. These functions can be described most efficiently as a hierarchy of functional statements beginning with the most encompassing, "top level" functions.

B. GTT Top-level Functions

A top-level function is a statement of a function performed by the system (the GTT) as a whole in response to a single major system purpose or objective. A top-level function is implemented by the entire system: equipment, personnel and software. There are three top-level requirements related to the GTT:

- Provide unit-level training in support of the ARTEP for the gunnery team performing the mission segment, Engage.

- o Control the expenditure of training resources, especially conserving the scarce, expensive resources.

- o Control the system (GTT) in training application, and evaluate and improve its capability.

Each of these top-level requirements is discussed below.

1. ARTEP Support

This function is the primary one performed by the GTT because it is the essential purpose of the GTT to provide the specified unit-level training, and because of this it must perform in the context established by the ARTEP. The ARTEP prescribes unit-level training and readiness assessment for all Army units based on the units' mission and equipment. For example, Manual 6-100 describes the ARTEP for the baseline system in this program. It is addressed to the Field Artillery Cannon Battery and specifies 13 Tables of Organization and Equipment (TOE) which include 105-, 155- and 203-mm howitzer batteries. Manual 6-100 states that, "This ARTEP is designed to give the FA cannon battery commander a collective training program." Thus, as a team (i.e., collective) trainer, the GTT represents one means for achieving part of that program. From this top-level function, several functions at the next lower level must be performed. These can be referred to as Tier One functions which are defined as functions that represent a part of the top level; that are definable entities (that is, they have a logical structure of input-process-output); and that are performed by one or more components of the system. The Tier One functions will be described following the discussion of the top-level functions.

2. Expenditure Control

This second top-level function has to do with a basic purpose of this program, which is to control the expenditure of, and to conserve, training resources. The design of the GTT has been largely determined by this function. Like all top-level functions, this one involves all system elements, but it is particularly implemented through the simulations incorporated into the system. While the GTT is defined to avoid the excessive use of fuel and to minimize projectile- and propellant-related expenditures, it is only one tool for unit training. Overall, the final responsibility for conservation of resources belongs to the unit commander.

3. GTT Control

This final top-level function represents the activities that are performed in applying the system to training, evaluating system performance, and planning and managing the growth and development of the system. The most significant aspect of this function is that it provides for system control during training. That is, the GTT is designed to implement good training practices: performance measurement, feedback, knowledge of performance, instructor control, a defined training procedure, etc. In addition, this top-level function provides "housekeeping." It implements the measurement and recording of system performance for evaluation and subsequent system growth and development.

C. Tier One Functions

These functions provide a greater level of detail in the description of the GTT. Since each involves only one or two GTT components, they are grouped here according to the most relevant component. The purpose of these functional statements is to serve as a basis for subsequent detailed design development. Generally, these functions do not describe a means of implementation. Since the GTT is based on available equipment--or equipment soon to be implemented--the means of implementation is usually clear. The parameters and performance measures associated with each function are not specified here. These values are better defined when the engineering design has led to specific means of implementation. A further comment on implementation is made at the end of this section.

1. Observer Simulator Functions

The chief contribution of the Observer Simulator to the GTT is to provide a realistic environment for the FO in detecting, locating and identifying targets. This simulator then must provide the targets within the realistic environment. Further, because the GTT is to provide performance measurement, including total team performance, the Observer Simulator must be integrated with the howitzer so that bursts/impacts can also be simulated and fed back for adjustment and/or evaluation of performance. Since the location of unit training can be any place the artillery is located and since unit training may be used to anticipate moves to new locations, the Observer Simulator must be capable of being initialized for a variety of environments. Finally, the Observer Simulator must provide some means of adaptation to the apparent scale of whatever viewing mechanism is employed. If feasible, the device should also be adaptable for use with a GLLD training device. The specific Tier One functions required in the Observer Simulator are:

a. Provide a number (TBD) of selectable or insertable visual environments that will approximate an observer's field of view and typical area of responsibility. An apparent size of approximately TBD meters wide is suggested, with a useful apparent range of TBD meters. The environments will include provision for simulating diurnal and seasonal changes.

b. Provide realistic representation of targets with a selectable number and type to satisfy the needs of any unit's mission. Precision of location of fixed targets is ± 0, moving target tracks TBD.

c. Provide realistic representation of impacts/bursts locatable to within ± (TBD) meters.

d. Interface with the Processor to integrate the selected environment with the calculated burst/impact data. Information would flow to and from the processor for this integration.

e. Provide a realistic field of view for one or two observers. Appropriate optical projection can achieve this; if any

compromise is required in the optical/viewing portion of the simulator, preference should be given to realism in the representation of environment and targets.

f. The augmentation of this simulator with appropriate sounds of incoming projectiles and burst or impact is desirable but is not judged to be essential.

It is anticipated that the Observer Simulator would be implemented as a video disc device similar to the proposed concept for Guard Fist II. Other reasonably precise means of depiction (of targets and environment) that are also capable of integrating target and impact locations precisely would be acceptable. The precision and fidelity of video disc representation are, however, well known, and in the course of this program there were several highly favorable comments received about the highly precise "locating" ability of the video disc technology. It is suggested that if the development of a GTT is pursued, the Guard Fist concept be reviewed and, if feasible, be incorporated in the GTT. Also, the support and guidance of the U.S. Army Training Support Center should be sought regarding video disc application.

2. FIST/FO DMD

The Digital Message Devices (DMD) used by the Fire Support Team and the Forward Observer are the operational equipment, linked to the Fire Direction Center in the normal, operational way. Both the FIST and the FO will process messages in the prescribed manner for the fire mission being exercised. The data concerning target location and burst/impact location will be synthetic, but this fact is not apparent to the FIST members or the FO.

The Tier One functions associated with the DMDs are:

- o Compose and edit fire mission messages.
- o Transmit and receive messages.

These devices will function in exactly the same way as in an operational or live-firing setting. They are simply connected to the related operational equipment and then process messages in the usual way.

3. Battalion Interface

In a real or simulated operational exercise, the Battery FIST receives target lists, planning information and guidance from Battalion. For the GTT, this input will be simulated. It is proposed on the basis of information available to this program that the Battalion interface can be accomplished through the concept of the Field Artillery School Fire Support Training System and/or the Artillery Control Environment. For the GTT, however, this simulated interface will be controlled through the GTT Processor. The only function provided by this component at the Tier One level is:

- o Provide guidance planning and target data simulated from the Battalion level.

4. GTT Processor

The processor in the GTT concept is the controlling element through which simulated parameters are entered and stored, performance measures translated among the several GTT elements, fire missions (or mission segments) selected for training, training and performance data collected and displayed, and appropriate firing tables and other synthetic data routed into the system. The GTT will provide for some number of selectable (insertable) physical environments, as well as a variety of target types and ammunition types. Associated with these parameters are some number of sets of ballistic and firing data to be used in technical fire control. These data must be stored and distributed from the processor. However, if these data are resident in the Battery Computer System Interface Simulator, the processor will perform only a "call up" and distribution function.

There is also a selection process within the conduct of training which arises from the GTT concept that allows team, section or individual training. Thus, the processor must implement this selection and control function. One very significant functional area in the processor has to do with the instructor interface. The GTT concept requires instructor moderation in the planning, conduct and evaluation of training. This will be implemented with one or more interface stations using, most likely, an interactive visual display terminal along with a printer. That interface will allow the instructor to plan and initialize training, control the training process and receive performance and other training data. In this way, the instructor is enabled to provide on-line feedback to the trainees, as well as feedback subsequent to training (i.e., debriefing). This interface also enables the control and monitoring of GTT operation. The GTT flow diagram (Figure 3, page 26) indicates three such interfaces. Actually, these may be implemented as a single physical unit, but the control and monitoring functions will be segmented by subsystem.

There are altogether 13 separate Tier One level functions that must be performed in the processor. These functions implement the GTT concept, as described in the paragraphs just above. Figure 4 depicts the 13 functions in the approximate sequence in which they would occur during a fire mission training exercise. The functions are named in the boxes along the top of the figure. Beneath each function are listed the information items and/or GTT components that are affected by the function. While these are properly identified as "processor" functions, it should not be inferred that they are entirely automatic. It is more generally the case that these functions include both equipment/software processes and manual processes. The relevant information will be presented to the instructor, which is the "monitor" part of these functions. Then the "control" part will be performed--or at least initiated--by the instructor. At this stage of development, it is not possible to designate the allocation of each function any more precisely. The equipment and software capability that is available will largely determine that allocation. Also, of course, the inherent characteristics of each function will be considered in its allocation. As a simple example, any "record" function would always be allocated to equipment for printing or tape storage.

These 13 functions are defined in terms of processor activity and, thus, exhibit some overlap between the training and the GTT management

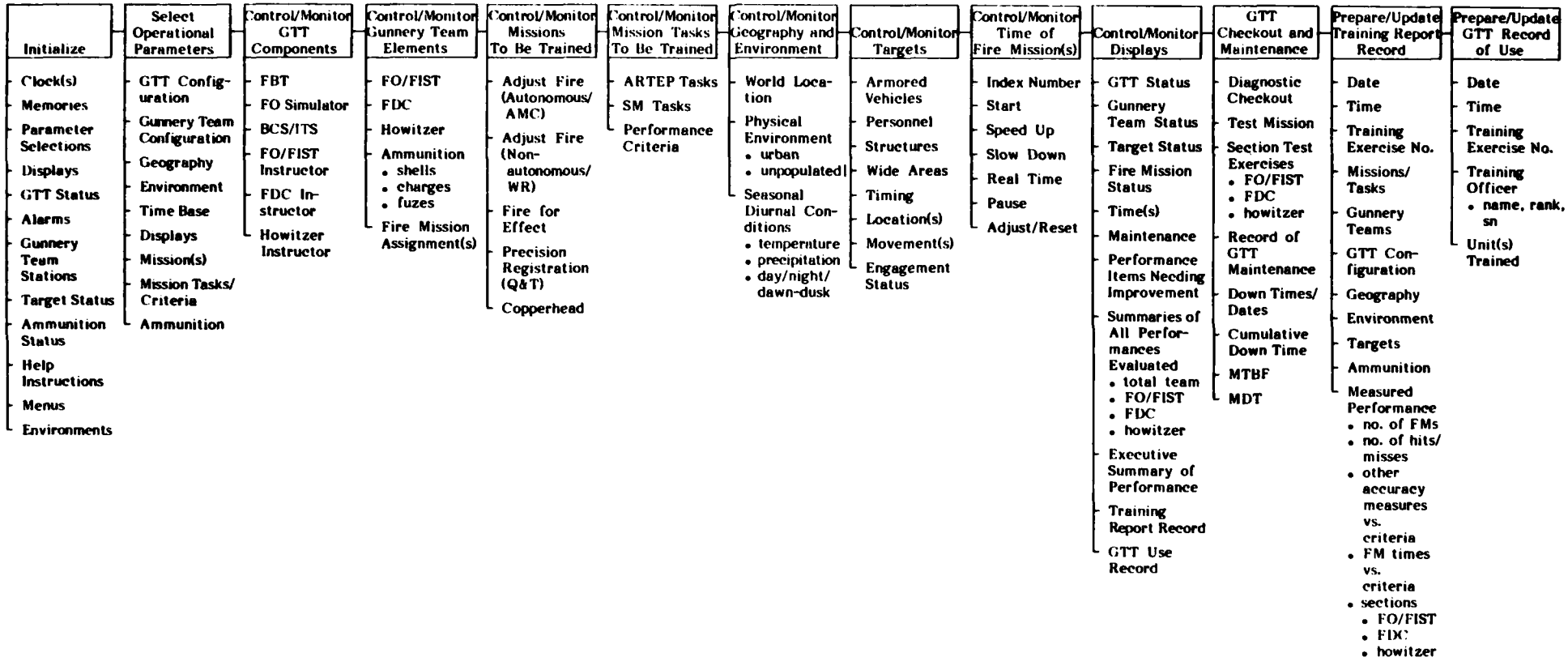

Figure 4. GTT Processor Functions.

activities. For example, the Control/Monitor Display function describes what is done, but the content includes both training performance information and system status information. Each of the processor functions is related in some way to the Instructor Interface, which is discussed next.

5. Instructor Interface

The instructor interface provides the means by which the instructor is integrated with the processor and with the training components of the system. This interface will provide for separate transactions between the instructor(s) and each subsystem. Because this interface relates to the processor, the functions described for the processor are linked to or overlap with the interface functions. Any of the "control/monitor" functions will have an identifiable interface with the instructor. In terms of instructor performance at the interface, there are three Tier One level functions:

a. Monitor and control training including initialization, monitoring and training exercise, as well as performance and control of the process including feedback and interrupt for instruction.

b. Monitor and control system (GTT) status and performance.

c. Compile and record training and system data.

6. BCS/ITS

The Battery Computer System Interface Training Simulator is a component designed by the artillery to provide simulated inputs to the BCS for training FDC and FIST personnel. It has been identified as a component of the GTT for its possible use as an interface between the processor and the FDC. The entire BCS/ITS will not be required in this application, but the Program Software Support and the Lesson Tape components may be useful in establishing this interface.

7. Fire Direction Center

This part of the GTT consists of the actual FDC, including the BCS and DMD. As noted earlier in regard to the FIST, the FDC will operate normally in all respects. The data being processed will be largely synthetic, but this will not be apparent to the FDC personnel. In the GTT the function performed at the FDC will be:

a. Receipt/review/forwarding of fire mission messages.
b. Development of technical fire direction messages.

8. Howitzer

This is the fourth of the operational components in the GTT. Like the FDC, the FIST and the FO, all of the howitzer tasks will be performed as in any operational exercise. The data in the gun order will be synthetic, but this is of no consequence to the gun section. Since the ammunition will always be a FASPR or similar reusable, limited range, practice round, the ammunition

handling task will be slightly less than fully realistic. The projectile will not be selected from among several types, but weight, size and handling characteristics will be consistent with real ammunition. There can be a mock fuze-setting drill. Also, the charge will not be selected and cut, but will always be the same practice unit. The function at the howitzer will be the same as in operations:

a. Receive and disseminate gun orders.
b. Set the gun in azimuth and deflection.
c. Insure howitzer safe to fire.
d. Load and fire.
e. Clear the howitzer and return to priority target settings.

9. Howitzer Simulations (FBT and FASPR)

In the paragraph above, the role of the FASPR has already been noted--to provide realistic handling characteristics in a round that will be fired only about 200 meters downrange. Because this is fired with such a light charge, the recoil simulator is required for realistic movement of the gun tube and exercise of sound and safe crew practices. The recoil simulator suggested is one now under development at USAFAS. The FBT, as proposed for use in the GTT, performs the functions of sensing and transmitting gun azimuth and elevation settings to the processor. It provides, in other words, gun crew performance measures. Because the FBT presently provides an instructor station, it may be integrated with the instructor interface at the howitzer. Depending on the architecture that emerges for the GTT, the FBT could be used almost entirely, or only its sensing and transmitting capability could be used. For the GTT it is the FBT concept that is important: the sensing of specified measures and their transmission for processing.

D. Implementation

The descriptions of the many functions which will be performed in the GTT are intended as a basis for further development. These descriptions do not contain sufficient guidance for an immediate design effort. They do provide guidance for the research of implementation means. As these means are identified, they can be compared to the function statements and the system requirements to arrive at a feasible implementation of the system. The process suggested here is a typical design development trade-off study. It is directed at selecting feasible means to fulfill the functions within bounds of cost, technological availability, etc. It should not be inferred that the process will be a lengthy one. The proposed GTT requires no really new development except for the observer simulator, and even that appears to be well within the state of the art. The GTT is intended to be a very practical device achievable in a relatively short time frame. It was purposely not conceptualized for a long-term advanced development.

One further comment on the functions has to do with the performance measures related to each one. The task analysis data contained in Appendix B include a host of task and task element performance measures. While all of these could be implemented, at least in theory, to do so would be impractical. It is proposed that if the GTT development is pursued, appropriate measures

can easily be selected from Appendix B. The approach would be to examine the Soldier's Manual task data for each system requirement (aggregated task) and select measures appropriate for each requirement, as well as being suitable to the mechanisms selected. The SM tasks in each aggregated task are identified in Appendix C. By going from Appendix C to Appendix B, the measures can be quickly compiled.

These comments conclude the presentation of the GTT functional description. In the next section of the report, a basic plan for using the GTT is presented.

VII. UTILIZATION

The GTT system implements realistic gunnery team training for the FA battery. The unit trainer (instructor) can utilize the system to conduct training for any type of indirect fire mission. The GTT system supports the guidance provided in the ARTEP and facilitates the training of the gunnery team to meet the ARTEP objectives. The GTT allows the instructor to tailor gunnery team training to meet specific unit needs. The instructor will insert the training parameters and control the operational flow of the fire mission events. He will be able to monitor the team's performance during training and can stop/slow down the fire mission events when it is apparent that intermediate performance standards are not met. The trainer can select an entire mission or can use the GTT to conduct remedial section or individual training. When the GTT is issued to a unit, it will be equipped with the basic control software so that the instructor will only have to select the initial conditions and operational parameters regarding the Gunnery Team Sections, Fire Missions, Fire Mission Tasks, Geographical Location and Seasonal/Diurnal Conditions associated with the training exercise. The GTT receives other necessary information from the instructor by means of menu-like checklists regarding the current GTT configuration, targets, ammunition resources, exercise/mission timing, displays to be used and moment-to-moment management of the training exercise. Other GTT features include maintenance and record-keeping functions which can be administered by the instructor.

The operational parameters obtained from the Fire Mission Descriptions are selected and entered into the system along with other data during initialization, and are used thereafter by the GTT in controlling, monitoring and evaluating the training exercise. Specifically, the Fire Mission Descriptions guide the instructor in selecting:

- Gunnery Team Configuration: The OSDs and IPOs show which Sections of the Gunnery Team are involved in the Missions/ Functions/Tasks to be trained.

- Ammunition: The OSDs and IPOs help define which kinds and quantities of shells, fuzes and charges are required for the training exercises.

- Mission(s): The OSDs help the instructor select the missions to be trained (e.g., Adjust Fire, FFE, Precision Registration, Copperhead).

- Mission Tasks and Criteria: The OSDs and IPOs provide the SM Task numbers, activities and effectiveness criteria for evaluating performance during training.

- Geography: The gunnery team's geographical area of responsibility and the IPOs both help in selecting the geographical context of the training exercises.

- Environment: The IPOs help in choosing the seasonal and diurnal (day/night) context of the training exercises.

By entering this information, the instructor informs the GTT who is being trained, with what armaments, on which missions, involving the evaluation of which task elements, and under what environmental combination of geography and local conditions.

It is the instructor's option to design the training exercises (by parameter selection) so as to accomplish any of several purposes, such as:

- o Broad assessment of all gunnery team skills.
- o Diagnostic evaluation in selected missions or tasks.
- o Corrective exercises involving a limited number of tasks or gunnery team sections.
- o Acquisition of skills in newly developed or modified missions.
- o Practice for maintaining proficiency in selected missions or tasks.
- o Research on gunnery team tactics or technologies.
- o Research on, or testing of, the GTT, itself.

Should new missions, tasks or tactics be of interest, the instructor or analyst may be required to develop new OSDs or IPOs so as to insure that all relevant factors are accounted for in the subsequent exercises.

Because the insertion of initial conditions can be extensive, when one considers effectiveness measures and criteria for every gunnery team task, it is suggested that whatever means of entry is selected, the Fire Mission Descriptions will be an essential source of information about sequences, performance measures and criteria. A final use of the Fire Mission Descriptions (in the training cycle) will be to aid the interpretation of the scores or measures produced by the GTT. The proposed record of training success will be most useful when presented to the trainee in the context of the operational mission. In other words, the descriptions will play a role in the feedback of results.

Considering the Fire Mission Descriptions very broadly as "source documents," they will provide input for the basic programming of the GTT, e.g.:

- o Task sequences for each mission type.
- o Performance measurements by type.

Also, as sources, they will be used to establish a specific exercise in terms of performance criteria, for example, and in terms of performance conditions and specific Soldier's Manual tasks. As has been noted, the descriptions also serve as source references for briefing and debriefing the gunnery team.

VIII. DISCUSSION

This section of the report provides a summing-up of the GTT development concerning issues not in the direct line of analysis and development. There is a review and comment on the whole program, followed by a note on the development of an index to denote task training requirements. After that note, there is a brief statement of the potential for applying the GTT to research in addition to its training role.

A. Program Review

In the course of this last program task, the entire program was reviewed, and the final revision and update of all of the earlier analyses were made. In this process it seemed appropriate to comment on the conduct of the program and to note the relative success of the approach. At the outset, this program was defined as one that would lead to an extensive, if not complete, use of synthetic training. Very early in the program this viewpoint was abandoned as being infeasible and not fully appropriate to the Field Artillery (at least in unit training). As the program progressed, it became increasingly apparent that the highly procedural nature of most of the gunnery team's tasks virtually required the use of actual equipment or physical simulations in order to achieve effective training. This was more apparent at each stage of analysis until, during the third program task, the concept for the GTT finally emerged. Until that time the accumulation and analysis of information about Soldier's Manual tasks and ARTEP tasks had yielded uniform and not very innovative or startling conclusions. With the exception of the observer tasks in target detection and location, the artillerymen's tasks were:

- Procedural and equipment-oriented.
- Suited to training through exercise of actual equipment.
- Lacking, almost completely, useful and quantitative definitions of performance that could be used in training diagnosis and evaluation.
- Perceived (by artillerymen) as quite nearly equal in criticality to system performance and more or less equally worthy of training effort.

These are valuable insights for training development, but information about training device applicability and utility was needed. It was to that end that program task three was directed. The results were not very encouraging. The artillery devices generally emulated actual operational equipment and were lacking in performance definition and measurement. Also, it was noted that these devices were not as fully used in the field as would seem desirable. Among possibly many reasons for this, it was concluded, is that the devices emphasized skill practice and not team performance. There were several things that worked to bring the need for highly realistic operational team training into a focus for this program. The device deficiencies noted above were one of these, as was the newly published ARTEP 6-100 which for the first time printed detailed sequences of task description. The result was the solidification of the need for realism in the GTT approach.

The concept that was eventually defined for the GTT depicts a system for training that is performance-based, and provides a high degree of fidelity through simulation, the use of actual equipment and the use of real fire mission procedures. The concept allows this realism in training with relatively modest expenditure of training resources because targets and environment are to be simulated for the observer, and the process of loading and firing is to be simulated with reusable, limited-range practice rounds. Also, the concept invokes good training practices through the use of instructors whose only job is training and the use of performance feedback and records. Finally, the concept reflects the need for control and management of the GTT, including evaluation of its effectiveness based on training accomplishments. While a true cost determination was beyond the scope of this program, it is judged that the implementation of the GTT concept will entail very moderate costs. The components of the GTT are: operational equipment, devices already available, a device that is conceptually defined and based on a proven technology and, finally, a processor and instructor/recording units that can be off-the-shelf items. This is not to say that further development is unnecessary. The observer simulator must be brought through the processes of engineering development and of production. Also, a substantial amount of software nd programming will be needed. However, the development cost will not approach the cost of totally new device development--especially not the cost of fully synthetic training. The GTT represents a very attainable system because it is composed of existing or nearly-so equipment. It is a major virtue of the GTT and, indeed, of its development that it is practical. The analytical tools used to develop it can easily be applied and understood, since they are essentially the traditional tools of training task analysis. The GTT, itself, being made up of operational equipment and only moderately sophisticated support components, can likewise be easily understood and used. Put another way, the GTT will provide performance-based training that can be implemented in the present Army training plan, using presently available personnel. It can be brought on line in a reasonably short period of time. The GTT does not mark a significant achievement in advanced training technology, but it does provide immediate and effective use of training resources. As already noted, its hallmark is practicality, and it provides for conservation of resources. Because it is designed to practice sound training procedures, it is also a noticeable step away from some presently poorly conceived training devices toward eventually more sophisticated, advanced training technologies.

B. Training Requirement Index (TRI)

One specific part of this program that merits special review at this time is the attempt to produce a single, encompassing index of training need for each task or combination of tasks performed by the gunnery team.

In the early stages of this program, a Training Requirements Index (TRI) was developed, which was intended to provide the analyst with a way of differentiating among tasks on the basis of their criticality and difficulty in system operation.* Theoretically, the TRI can have 26 values from a low of 8

*TRI = (System Performance Effects + Delay Tolerance)^2 + (Task Difficulty + Practice Required)^2 where the possible ratings are a) System Performance Effects: 1,2,3; b) Delay Tolerance: 1,2; c) Task Difficulty: 1,2,3,4; and d) Practice Required: 1,2,3,4,5.

to a high of 106. In actual practice, when calculated from the SME ratings of gunnery team tasks, only 10 TRI values were found across 56 SM tasks. They ranged from 25 to 89, and tended to cluster markedly at a specific value for each Section, the modes being 74 for the FO/FIST Section, 74 for the FDC Section, and 61 for the Howitzer Section. Between 60% and 80% of all TRI ratings fell at the mode for each section. There were 22 TRI ratings of 74 at the FO/FIST and 11 TRI ratings of 74 at the FDC. In view of this outcome, the primary differentiation was found to exist not between individual SM tasks so much as between Howitzer Section tasks as a whole (mean TRI = 58), FO/FIST Section tasks as a whole (mean TRI = 66), and FDC Section tasks as a whole (mean TRI = 74). Some of that Section differentiation altered when the larger number of tasks were aggregated into a smaller number for each Section, although the Section rankings remained the same with the Howitzer Section being lowest.

Approximately 18 of the 56 original SM tasks were clearly identified through the TRI as being more or less significant than the average, with 13 of them being in the FO/FIST Section where the largest number of SM tasks is found. However, it is felt that the pronounced clustering of TRI ratings may still hide some of the real differences in criticality or difficulty. Since there remains considerable confidence in the TRI as a useful index, the reasons for poor differentiation were sought primarily in the manner by which SME ratings were generated. One speculation considers the possibility that the SMEs, who are truly experts in the use of the older equipment, may have been somewhat less familiar with tasks employing such newly emerging devices as the BCS, GDU, DMD and FIST/DMD. There also remains the possibility that the TRI (which was adapted from an earlier ARI methodological study) can be made a little more sensitive, both in the individual ratings (System Performance Effects, Delay Tolerance, Task Difficulty and Practice Required) and in the manner by which they are combined into the single index.

Efforts at improving task differentiation through the TRI would be justified if a clear need can be demonstrated for allocating scarce resources to the training of selected tasks. The GTT concept, however, provides an integrated system that can be used in training all tasks, and training sequences based on the OSDs would tend to give apparent equal emphasis to all tasks. Consequently, the need for an index for the allocation of training resources appears to be less urgent now than when this program began. Attempts to improve the TRI differentiation capability thus are not recommended in the context of the GTT. The concept remains valid and even though its realization seems elusive, it should not be abandoned.

C. GTT Research Application

Three basic features of the GTT make it highly useful for purposes beyond the direct training of the gunnery team:

- It focuses on the entire team (FO/FIST, FDC, Howitzer Sections)
- It generates the most meaningful measures of individual and team effectiveness.
- It creates a record of effectiveness under various operating conditions.

One of the most important additional purposes that such features serve is to conduct research into the many aspects of FA operations. Effectiveness can be measured under a variety of optional operating conditions and training procedures. Data bases can be generated economically and with a sufficient number of measures under controlled conditions, so as to yield statistical reliability beyond that otherwise possible. Data reduction and analysis can be conducted rapidly and efficiently with the aid of computers, because many of the parameters and measures will exist within the GTT's instrumentation. The necessary digital or analog data can be tapped off without human intervention for computer-aided immediate analysis. Retrospective analysis can be carried out from the GTT's hard copy records of those same data. The following paragraphs enlarge upon some specific ways in which the GTT is useful as a research tool.

- o It can accommodate new devices, simulations, methods and manning.

  The GTT's sensors, displays and controls interface with the operational equipment in ways that can accommodate most variations in that equipment. The GTT measures and evaluates basic or universal parameters (e.g., howitzer settings, time-to-fire intervals), even though crews may employ new or modified procedures in carrying out their tasks. The GTT is thus largely independent of variations in operational equipment and manning or methods of operation.

- o It can create the experimental and control conditions of interest.

  Operational scenarios for research purposes can be programmed into the GTT software or curricula. Specific equipment configurations, target loads, geographical conditions, and other parameters can be varied to accommodate the researcher's objectives.

- o It can exercise the team in real time, adaptive, experimental scenarios.

  Because GTT is so highly automated, instrumented and controllable, it can provide the dynamic, natural sequencing and responses associated with real-time operation. Sensing, measurement and data processing thus occur in real time, along with record-keeping. Diagnostic analysis can take place immediately by virtue of the on-line, computer-aided data analysis features. Consequently, there can also be a rapid adaptation of experimental exercises to concentrate analyses in critical or weak areas.

- o It can produce abundant useful data rapidly, safely, reliably and economically.

  The automated nature of the GTT facilitates the generation and recording of operator performance data, in programmable formats, with immediate data reduction and analysis when necessary. The GTT's interconnecting data link, solid state design, microprocessing components and related software result in much higher intrinsic reliability than would be obtained with the older electromechanical, hard-wired devices. The incremental space and financial costs

associated with this research capability are kept low for the same reasons. The research-related apparatus can be transported readily, along with the operational equipment. Overall safety is increased because of the reduced need for (and hazards of) live ammunition, large ranges and excessive fuel. Those reductions come as a result of the GTT's ability to simulate so many of the operational conditions and responses on the parts of the battery, the environment and the enemy.

The application of GTT to FA research can help achieve the long-sought improvements in target detection and identification, target locating, fire planning and fire execution for all the many missions required of the howitzer battery. The flexibility of the GTT allows for change and growth of that research capability as new weapon systems are developed and tactics are modified.

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GLOSSARY

ACE - Artillery Control Environment
ADFT - Artillery Direct Fire Trainer
ADP - Automatic Data Processing
AG - Assistant Gunner
Ammo - Ammunition
Aug Opl Eqt - Augmented Operational Equipment
ARI - U.S. Army Research Institute for the Behavioral and Social Sciences
ARRADCOM - Army Armament Research and Development Command
ARTBASS - Army Training Battle Simulation System
ARTEP - Army Training and Evaluation Program
ATSC - See USATSC
BCS - Battery Computer System
BCS/ITS - Battery Computer System Interface Training Simulator
BRL - Ballistic Research Laboratory
C [C1,C2,C3,C4] - Cannoneer [number indicates cannoneer position number]
CAMMS - Computer Assisted Map Maneuver Simulation
CATTS - Combined Arms Tactical Training Simulator
C/C - Control/Coordinate
Ch Sec - Chief of Section
CLTC - Closed Loop Training Concept
COHORT - Cohesive Operational Readiness Testing
COLTSIM - Company/Team Level Training Simulation System
Demo Mtls - Demonstration Materials
DF - Deflection
DF - Direct Fire
DIVARTY - Division Artillery
DMD - Digital Message Device
EOM - End of Mission
ETHER - Realtime Software Simulation of Communications Nets
ETM - Extension Training Material
(F) - Fire
FA - Field Artillery
FADAC - Field Artillery Digital Automatic Computer
FASCAM - Family of Scatterable Mines
FAFSTS - FA Fire Support Training System
FASPR - Field Artillery Shootable Practice Round
FBBC - First Battle: Battalion-Corps
FBT - Firing Battery Trainer
FDC - Fire Direction Center
FDO - Fire Direction Officer
FD Specialist - Fire Direction Specialist
FFE - Fire for Effect
FIST - Fire Support Team
FIST Ch - Fire Support Team Chief
FIST DMD - Fire Support Team Digital Message Device
FIST V - Fire Support Team Vehicle
FM - Fire Mission
FO - Forward Observer
FOT - Forward Observer Trainer

(FP) - Fire Plan
FSO - Fire Support Officer
FS Sgt - Fire Support Sergeant
G - Gunner
GDU - Gun Display Unit
GLLD - Ground Laser Locator Designator
G/VLLD - Ground/Vehicular Laser Locator Designator
G/VLLD-T - Ground/Vehicular Laser Locator Designator-Trainer
G/VLLD-TV - G/VLLD with television camera
HC Smoke - White Smoke Projectile
HD - Howitzer Driver
HE - High Explosive
HEL - Human Engineering Laboratory
IF - Indirect Fire
IFES - Indirect Fire Engagement Simulation
Instr - Instructor
IOC - Initial Operating Capability
IPO - Input-Process-Output
ISD - Instructional Systems Development
JWG - Joint Working Group
(L) - Load
LITR - Low Cost Indirect Fire Training Round
LRF - Laser Range Finder
MACOM - Major Army Command
MILES - Multiple Integrated Laser Engagement System
MLRS - Multiple Launch Rocket System
MMT - Miniature Moving Target
MOS - Military Occupational Specialty
MOUT - Military Operations in Urbanized Terrain
N/A - Not Applicable
Opl Eqt - Operational Equipment
Pantel - Panoramic Telescope
PD - Point Detonating (Fuze Action)
PM-TRADE - Program Manager-Training Devices
QE - Quadrant Elevation
RFAF - Request for Additional Fire
SAWE - Simulation of Area Weapons Effects
SCA - Section Chiefs Assembly
SIMFIRE - Simulated Fire
Sims - Simulator(s)
SM - Soldier's Manual
SMEs - Subject Matter Experts
STABS - Stand Alone Tactical Artillery Battle Simulation
STAGS - Simulated Tank Antiarmor Gunnery System
TACF - TACFIRE
TACFIRE - Tactical Fire Direction System
TASC - Training and Audiovisual Support Center
TBD - To Be Determined
TDs - Training Device(s)
TDLRs - Training Device Letter Requirement(s)
TDNSs - Training Device Need Statement(s)
TRI - Training Requirement Index
TOE - Table of Organization and Equipment

TOW - Tracking Optical Wire Guided Missile
TSFO - Training Set Fire Observation
TV - Television
USAFAS - U.S. Army Field Artillery School
USATSC - U.S. Army Training Support Center
VAC - Volts Alternating Current
VDC - Volts Direct Current
VFMED - Variable Format Message Entry Device

APPENDIX A

REPRESENTATIVE FIRE MISSIONS

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APPENDIX A

REPRESENTATIVE FIRE MISSIONS

A. Introduction

This appendix contains a description of the derivation of a representative set of fire missions. Each mission is described in a brief narrative as well as in an Operational Sequence Diagram (OSD). This information can be programmed into the GTT to provide for unit training of the total gunnery team as well as for section training. The essential purpose of structuring training in terms of actual fire missions is to achieve a high level of realism. By using the fire missions appropriate to a unit's responsibility, the team is trained to perform as it will in combat and perfect their skills using real procedures, messages and equipment.

The use of these descriptions as conceptualized for the GTT has been described in Section VII of this report. These materials can also be used in any other training. They are complete and accurate descriptions of the indirect fire process in howitzer systems typified by the baseline. Thus, they can provide structure for a live or a dry firing exercise or could even be used in a classroom setting for indoctrinating gunnery teams. These descriptions can also serve as guidance--perhaps even as a checklist--for both instructors and trainees.

In the discussion preceding the actual descriptive material, the relationship between the descriptions and the ARTEP manual for the baseline is presented. This is done to demonstrate the correspondence between the two documents which provides a "validity check." More importantly, since the ARTEP is the official means by which total unit training is implemented, this "crosswalk" demonstrates the completeness of the GTT approach.

Just a brief summary of the GTT approach will help the understanding of the descriptive material to follow.

The GTT will be comprised of instrumented operational equipment and devices and simulations that permit each of the gunnery team subsystems (FO/FIST, FDC and Howitzer Sections) to perform in an integrated fashion to accomplish training objectives. The primary function of the GTT is as a unit training system for training, improving and exercising gunnery team skills, knowledges and attitudes that are necessary for successful performance of indirect fire missions. The GTT is unique in that it will provide the capability to exercise any representative fire mission that the gunnery team is expected to perform in combat. Gunnery team performance will be measured on-line for immediate evaluation of performance and for evaluation and diagnosis of performance during and after the conduct of training.

B. GTT Relationship to the ARTEP

In conducting gunnery team training, the GTT system strives to accomplish the same objectives as the ARTEP. Both the ARTEP and GTT system require hands-on, performance-oriented training to train, diagnose deficiencies and evaluate combat readiness. The difference between the two is

that the ARTEP is a collective training program for an entire unit performing all mission segments; whereas the GTT system focuses on only the Engagement mission functions and tasks, i.e., the integrated conduct of fire tasks performed by the gunnery team. For the FA unit, the ARTEP prescribes the tasks, combat condition and performance standards that must be accomplished during the Emplace, Engage, March Order and Move mission segments. This program recognizes that an FA unit must train in each of these mission segments. However, as pointed out previously, the training resources associated with live firing during the Engagement mission segment are becoming less and less available. The GTT strives to be the training vehicle by which ARTEP Engagement mission tasks can be trained, diagnosed and evaluated with equal or better training effectiveness, while at the same time reducing training resource costs. Through simulations and devices, the GTT will be able to expand ARTEP tasks to include fire missions with various types of special ammunitions such as the improved conventional munitions, the family of scatterable mines and numerous Copperhead missions at moving and/or stationary targets.

The ARTEP manual of the baseline system, 6-100: The Field Artillery Cannon Battery, 17 February 1984, presents training and evaluation outlines of doctrinal mission(s) and tasks organized by battery section and platoon. The combat readiness/effectiveness of the battery, section, or platoon can be inferred by its ability to perform the ARTEP tasks. ARTEP 6-100 designates the mission of the Field Artillery Cannon Battery as "Provide Field Artillery Fires." To accomplish the battery mission, each gunnery team section has the following supporting mission:

Gunnery Team Section/Platoon	ARTEP Mission Number	Mission
FO/FIST	3-III-2	Provide Forward Observations
FIST Headquarters	3-III-1	Provide Fire Support Coordination
FDC (Battery)	3-I-6	Provide Fire Direction Support
Howitzer Section	3-I-7	Provide Howitzer Support

For each gunnery team section, the ARTEP further identifies the tasks/subtasks, supporting soldier manual tasks, (combat) conditions, and training (performance) standards which must be performed to accomplish the section/platoon mission. However, ARTEP tasks and subtasks within each (section) mission are not presented in any "tactical or technical order."

It is appropriate at this point to note a problem with the use of certain key words: mission, function and task. In traditional training analysis, these words have a practically universal connotation. However, in the source documents used in this program, they have different connotations determined by context.

The word "mission" is used to denote the overall purpose or objectives of a unit, such as "Provide Field Artillery Fires" (which is the mission of the baseline system). The word is also used in the phrase "fire mission" to denote specific activities to carry out a particular kind of artillery firing, such as high explosive or illumination. A final usage of "mission" is in the ARTEP which uses the word to denote a group of functionally related tasks, such as "Provide Howitzer Fires." In that usage, all fire missions and methods of fire are subsumed under "Provide Howitzer Fires."

The word "task" has two distinct uses: in the Soldier's Manual, it is used to denote an activity performed by one person individually or working together with other crew members. This usage is quite close to that which is common to many tasks analysis methods. However, in the Soldier's Manual, there are wide differences in the complexity of tasks. Some involve many discrete activities, any one of which could be defined as a "task." Others appear to be a single, definable activity with input and output which traditionally characterize a "task." In the ARTEP, the phrase "ARTEP task" is used to denote a set of functionally related activities made up of several Soldier's Manual tasks. This mixed usage makes it difficult to convey previse meanings. The following comparison of traditional usage with ARTEP usage will help clarify meanings:

Traditional Term	ARTEP	Example
Mission	Mission	"Provide Direct Support"
Mission Segment	(none)	"Occupy, Engage, March Order, Move"
Functions	ARTEP Tasks	"Conduct Indirect Fire Mission," etc.
Tasks	Soldier's Manual	"Request and Adjust Area Fire," etc.

Prior to organizing the representative fire missions, an analysis was performed to determine the relevant ARTEP tasks which may be performed during the Target Engagement process by the gunnery team. The results of this analysis are shown in Figure A-1.

1. Target Engagement Process and a Description of Fire Missions

The Target Engagement process is initiated by the FO/FIST once a target has been acquired. The target is located and a call for fire is prepared and transmitted to FDC. The remaining processes interactively involve both the FDC to provide the required fire direction support and the howitzer section(s) to produce the cannon fires. The observer requests any required subsequent adjustment prior to fire-for-effect. The process is terminated when the desired effect on the target has been achieved. For FO/FIST, ARTEP Task 3-III-2-3,

Section		ARTEP Tasks
FO/FIST	3-III-2-2	Locate Targets
	3-III-2-3	Conduct Indirect Fire Missions
	3-III-2-3a	Conduct Adjust Fire Missions
	3-III-2-3b	Conduct Fire for Effect Missions
	3-III-2-3c	Conduct a Precision Registration
	3-III-2-3d	Observe Munition Effects and Report Battle Damage Assessments
FIST Headquarters	3-III-1-3	Coordinate/Control Fire Support Assets on Surface Targets
	3-III-1-3b	Monitor/Process Requests for Immediate Fire Support
	3-III-1-3c	Perform Target Analysis
	3-III-1-6	Locate Targets of Opportunity and Transmit Calls for Fire for Copperhead
	3-III-1-6a	Designate Target of Opportunity for Copperhead

Section		ARTEP Tasks
FDC (TACFIRE/ BCS)	3-I-6-6b	Determine and Update Registration Data
	3-I-6-6c	Determine Replot Data
	3-I-6-7	Attack Targets
	3-I-6-7a	Determine Method of Attack
	3-I-6-7b	Issue Battery Fire Order
	3-I-6-7c	Process Battalion Fire Order
	3-I-6-8	Determine Firing Data
	3-I-6-9	Control/Coordinate Fire Missions
	3-I-6-9a	Control/Coordinate Registrations
	3-I-6-9b	Control/Coordinate Adjust Fire Missions
	3-I-6-9c	Control/Coordinate Fire-for-Effect Missions

Section		ARTEP Tasks
Howitzer	3-I-7-2	Execute Fire Commands
	3-I-7-2a	Process Fire Commands
	3-I-7-2b	Prepare Ammunition for Firing
	3-I-7-2c	Load Howitzer
	3-I-7-2d	Lay Howitzer for Direction and Quadrant
	3-I-7-2e	Fire the Howitzer
	3-I-7-1g	Lay on Planned Priority Target

Figure A-1. ARTEP 6-100 Tasks Which May be Performed During the Engagement Mission Segment by the Gunnery Team

Conduct Indirect Fire Missions, identifies three categories of fire missions directly involving the gunnery team, i.e., adjust fire missions, fire-for-effect missions and registration missions. A fourth category is identified by ARTEP Task 3-III-1-6, Locate Targets of Opportunity and Transmit Calls for Fire for Copperhead. Within each of the categories, the ARTEP identifies the following types of fire missions.

a. Adjust Fire Mission

This type of fire mission is conducted whenever the target location cannot be accurately determined by the observer. Consequently, an adjustment of artillery fire may be required to adjust the impacting rounds relative to the target in range, lateral deviation and/or height of burst. The ARTEP identifies the following adjust fire missions:

- o Low and high angle adjust mission
- o Final protective fire adjust mission
- o Assault fire mission
- o Destruction mission
- o Simultaneous mission
- o Quick smoke mission
- o Illumination mission
- o High explosive under illumination adjust mission
- o Large or irregularly shaped target adjust mission

The observed fire Soldier's Manual tasks performed by the observer in initiating adjust fire missions and requesting subsequent adjustments are identified in SM 6-13F, Fire Support Specialist, as follows:

SM Task No.	Task Name
061-283-1011	Request and Adjust Area Fire
061-283-1021	Request and Adjust Continuous Illumination
061-283-2001	Request and Adjust Area Fire Using Creeping Procedures
061-283-2002	Request and Adjust Final Protective Fires
061-283-2003	Request and Adjust Fire on Irregularly Shaped Targets
061-283-2004	Request and Adjust Area Fire Using Sound Adjustment Procedures
061-283-2022	Build and Maintain a Quick Smoke Mission
061-283-2103	Conduct a Destruction Mission

b. Fire-for-Effect Mission (FFE)

Observer initiated FFE missions are conducted when little or no artillery fire adjustments and/or immediate artillery effect on a target at a known location are required. They may be fired on planned target locations or targets of opportunity. The ARTEP identifies the following fire-for-effect missions:

- o Fire-for-effect (planned or accurately located target) mission
- o Immediate suppression mission
- o Immediate smoke mission
- o Priority target mission

The observed fire Soldier's Manual tasks performed by the observer in initiating and conducting FFE missions are identified in SM 6-13F as follows:

SM Task No.	Task Name
061-283-1013	Conduct a Suppression Mission
061-283-1014	Conduct an Immediate Suppression Mission
061-283-1015	Conduct a Fire-for-Effect Mission
061-283-2021	Conduct an Immediate Smoke Mission

c. Registration Mission

Registration missions are conducted to determine firing data corrections for non-standard conditions, errors in battery location, errors in the lay of the howitzers, errors in the firing chart and performance differences in ammunition lots. Although there are several types of registration techniques which may be employed, e.g., high burst/mean point of impact (HB/MPI), precision, abbreviated HB/MPI, etc., the ARTEP identifies "Conduct a Precision Registration, Quick and Time" as the type of registration task performed by an observer. The SM task which supports this mission is 061-283-2102 entitled, "Conduct an Impact and Time Registration."

d. Copperhead Mission

This type of mission is typically conducted against armored targets (moving and/or stationary) when the observer is equipped with a ground/vehicular locator laser designator (GLLD) and Copperhead ammunition is fired. The following supporting observer SM tasks may be performed in initiating and conducting this type mission:

SM Task No.	Task Name
061-274-3973	Lase a Stationary Object
061-274-3974	Lase a Moving Target
061-274-3976	Lase a Stationary Target (limited visibility)
061-27403977	Lase a Moving Target (limited visibility)
061-274-3979	Adjust Indirect Fire with GLLD
061-274-3989	Designates a Target for Laser Guided Munitions

2. Gunnery Team Baseline System

For purposes of this program, the baseline system analyzed was the gunnery team system within a "Division 86" 155mm Self-Propelled Field Artillery Battalion. Further, the OSDs were to describe the sequential functions and

tasks performed by the gunnery team during target acquisition and target engagement utilizing advanced artillery equipment and digital communications. These equipments include the Fire Support Team Digital Message Device (FIST DMD), Digital Message Device (DMD), the Battery Computer System (BCS), the Ground Laser Locator Designator (GLLD), TACFIRE, etc. The development of the OSDs considered both non-autonomous and autonomous operations, i.e., under battalion TACFIRE control (non-autonomous) and without TACFIRE control (autonomous). Tasks performed within battalion FDC (TACFIRE) were not analyzed. Only those gunnery team fire mission communication tasks that interact with the TACFIRE system are contained in this analysis.

a. Sources of Information

ARTEP 6-100 provided the structure for the team's functional relationship and to some degree the sequencing of SM tasks within the fire missions. The SM's identify reference material, i.e., Field Manuals (FM's), Technical Manuals (TM's), and other reference materials which were an aid in developing the flow of functions and tasks. Generally, FM's describe tactics, doctrine and employment techniques, while TM's provide operator equipment procedures. At the time of the OSD development, operator tasks and procedures were not fully documented for the following equipment: BCS, FIST DMD, GLLD, GDU, and DMD. For this advanced equipment, operator tasks and sequences were derived from draft contractor publications, equipment functional descriptions and/or equipment operational and organizational plans. Descriptions of operator tasks and fire mission flows were also obtained from USAFAS artillery subject-matter experts (SME). The experience of the program staff with operational and developing systems was also applied.

b. Representative Fire Missions

For each of the four fire mission categories, a fire mission was selected as being representative of all the fire missions in a particular category. The depicted missions include the tasks performed by the gunnery team in the engagement process. The following fire missions were selected:

Adjust Fire Mission

Low Angle, Adjust Fire, When Ready (WR), Non-autonomous
Low Angle, Adjust Fire, At My Command (AMC), Autonomous

Fire-for-Effect Fire Mission

Fire-for-Effect, Target of Opportunity, When Ready, Autonomous

Registration Fire Mission

Precision Registration, Quick and Time

Copperhead Fire Mission

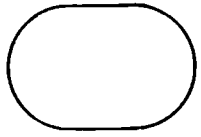
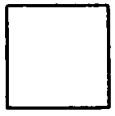
Copperhead, Target of Opportunity, Autonomous

3. Developing the Operational Sequence Diagrams (OSDs)

The ARTEP tasks and supporting SM tasks were systematically organized to develop representative fire missions that depict the sequential flow of gunnery team functions and tasks during the conduct of a fire mission. Operational Sequence Diagrams (OSDs) were developed for each representative fire mission.

Before presenting the OSD fire mission descriptions, it is perhaps helpful to understand the OSD technique. The OSD is a symbolic and verbal representation of functionally related tasks for a particular system under specifically designated operating conditions. It contains a sequential arrangement of annotated symbols and operational flow lines within and between the individual operating subsystems (elements or work stations) that comprise the system of interest. The operational sequence defines the consecutive activities that are carried out in completing a particular mission under a given set of environmental, tactical and organizationally imposed conditions. Because it organizes the set of tasks in a systematic way by individual operating subsystems, the OSD can serve as a tool for analyzing workloads for each subsystem, determining requirements for controls/displays/communications and assessing time requirements. In addition, it can serve as a model for mission simulations, and facilitate diagnostic studies of system or mission efficiency. Finally, it can provide a structure for the development of training programs, by identifying what must be accomplished, by which personnel or equipment, in what sequence and in what time period.

The OSDs developed for this program show the sequence of functions and tasks beginning with "Locate Targets" and ending with "End of Mission." Where appropriate, each function is keyed to its ARTEP Task Number, e.g., observer ARTEP task 3-III-2-2, Locate Targets, and SM tasks are numbered and titled. Each function and task is listed, in order, at the left of the diagram. Across the top of the diagram are named the positions within the gunnery team arranged by section. On the diagram, a solid line depicts the flow among the positions for the information or other output of each function. Broken lines indicate an alternative flow of information. Each function is connected by a divided line to the point on the diagram at which it occurs. The symbols and their meanings are shown in Figure A-2.

SYMBOLS	ACTIVITY
	Function/Task, appears with others in a fixed sequence
	Function/Task, appears alone. May take place concurrently, but not in any fixed relative sequence, with other tasks.
	Observe/Monitor
	Operate
	Transmit
	Receive
	Operate (Alternate Assignment)

Other Notations

000-000-0000	Soldier's Manual Task
TBD	To Be Determined

FIST Section	Fire Support Team Section
FO	Forward Observer
Fs Tm Ch	Fire Support Team Chief
Fs Sgt	Fire Support Sergeant

BTRY FDC	Battery Fire Direction Center
FDO	Fire Direction Officer
Ch FD SP	Chief Fire Direction Specialist
SR FD SP	Senior Fire Direction Specialist
FD SP	Fire Direction Specialist

HOWITZER Section	
Ch Sec	Chief of Section
G	Gunner
AF	Assistant Gunner
C	Cannoneer (Number 1-5)

Figure A-2. OSD Symbols and Notations

C. Description of OSD Representative Fire Missions

The following paragraphs are descriptions of each of the OSD depicted missions and are related to the ARTEP sequences.

1. Low Angle, Adjust Fire Mission, When Ready, Non-autonomous

This fire mission is shown in Figure A-3 on the following page . The mission flow is initiated by the FO of the FIST section by performing the function "Locate Target" (ARTEP Task 3-III-2-2). As shown on the diagram, the FO can locate the target by performing any one of four supporting SM tasks, e.g., locate by grid coordinates, polar plot, shift from a known point, etc. Once the target is located, the observer performs function 3-III-2-3a, Conduct Adjust Fire Mission, by preparing and transmitting his call for fire. In performing function 3-III-1-3b, Monitor/Process Request for Immediate Fire Support, the FIST Headquarters, via the FIST DMD, has several options depending on how the observer appears in the FIST DMD subscriber file, i.e., in the "Review" mode, "Fire Request Approval" mode, or "Automatic" mode. Once transmitted through the FIST DMD, the fire mission is received by TACFIRE who performs the tactical fire control solution, transmits the FM;FC to the battery FDC, message to observer (MTO) and FM;RFAF to the battalion fire support officer (FSO). Upon receipt of the FM;FC message, the battery FDC performs functions 3-I-6-7c, Process Battalion Fire Order; and 3-I-6-8, Determine Firing Data, which result in the transmitting of the gun orders to the howitzer section. The howitzer section performs function 3-I-7-2a, Process Fire Commands, and all supporting functions to produce the initial howitzer fires, i.e., 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Deflection and Quadrant; 3-I-7-2c, Load Howitzer; and 3-I-7-2e, Fire Howitzer. The howitzer section's Chief-of-Section transmits SHOT on ROUNDS COMPLETE via the Gun Display Unit (GDU). The battery FDC transmits SHOT and SPLASH messages, as appropriate. Upon observing the impact of the round(s), the observer performs function 3-III-2-3a, Conduct Adjust Fire Mission, in determining and transmitting the subsequent adjustment (SUBS ADJ). Depending on the FIST DMD subscriber table, the SUBS ADJ message is processed through FIST to TACFIRE. TACFIRE transmits an FM;FC message to the BCS. The battery FDC and howitzer section perform the same tasks in determining firing data and processing the gun orders during the first and second subsequent adjustments. After the howitzer section has completed the fire-for-effect (FFE) phase of the mission, the observer performs function 3-III-2-3c, Observe Munition Effects and Report Battle Damage Assessment, and transmits end of mission (EOM) to TACFIRE. The battery FDC receives the EOM and transmits EOM to the howitzer section. The howitzer section receives the EOM message, acknowledges and ends by performing function 3-I-7-1g, Lay on Priority Target.

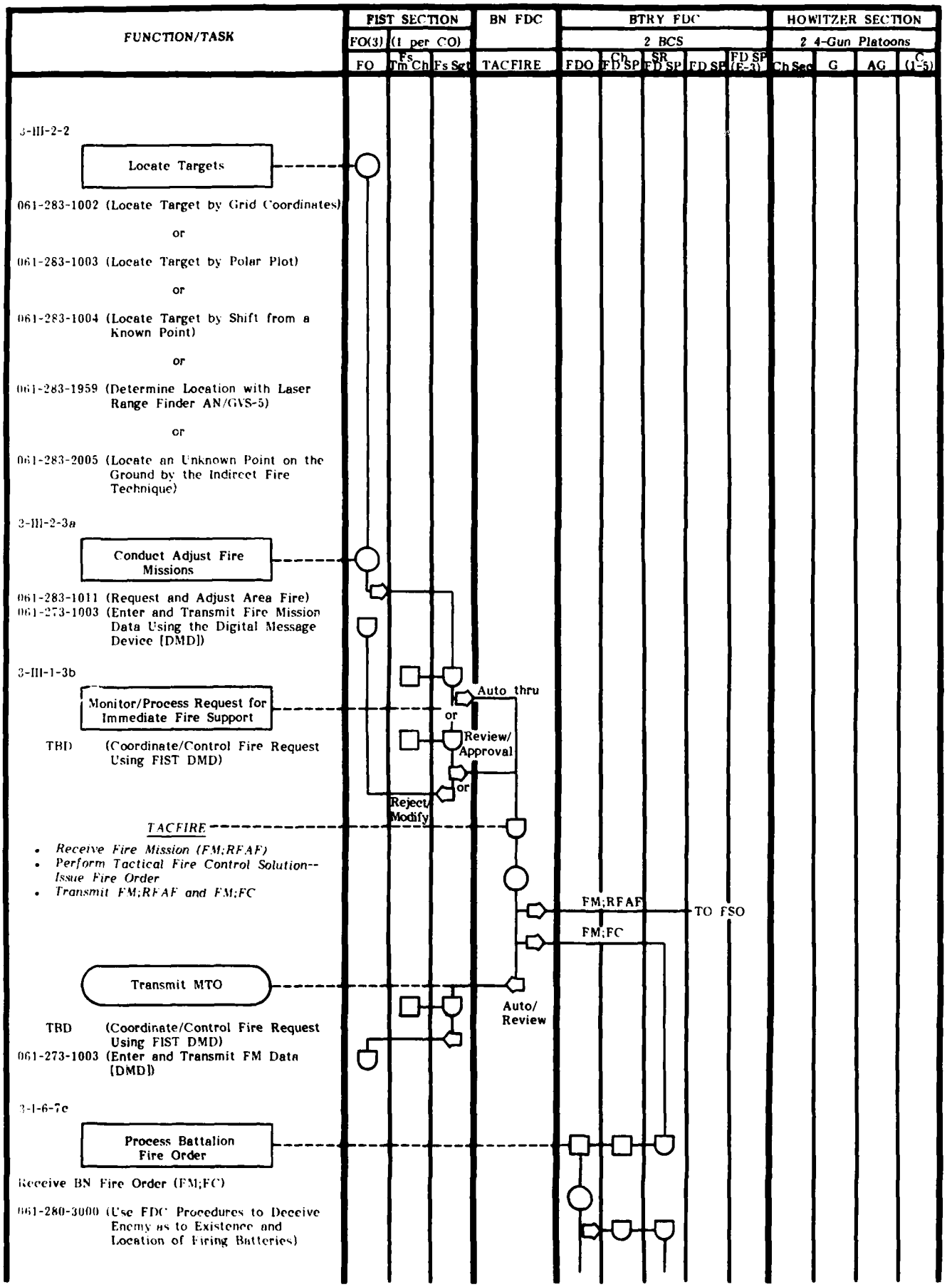
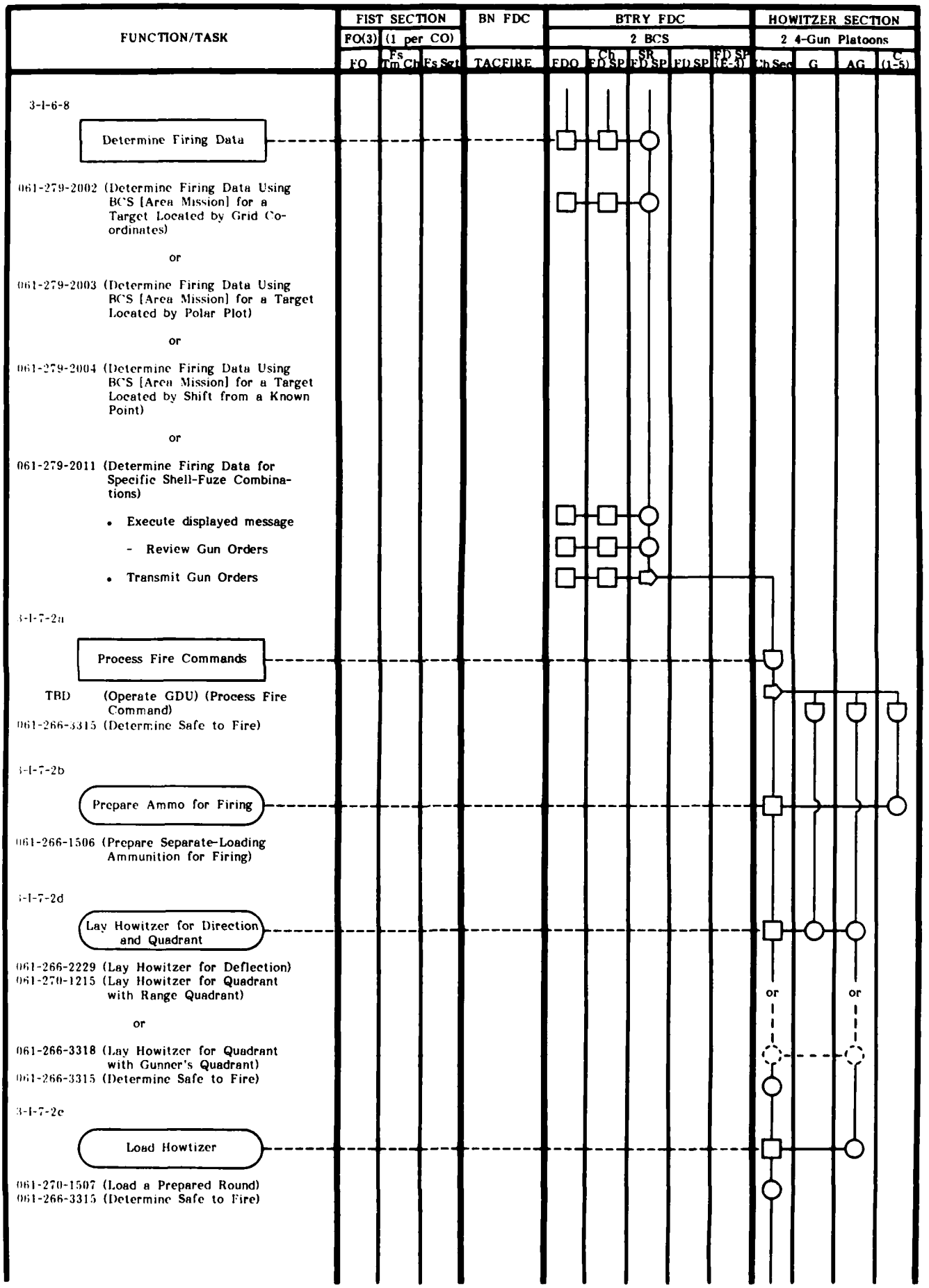
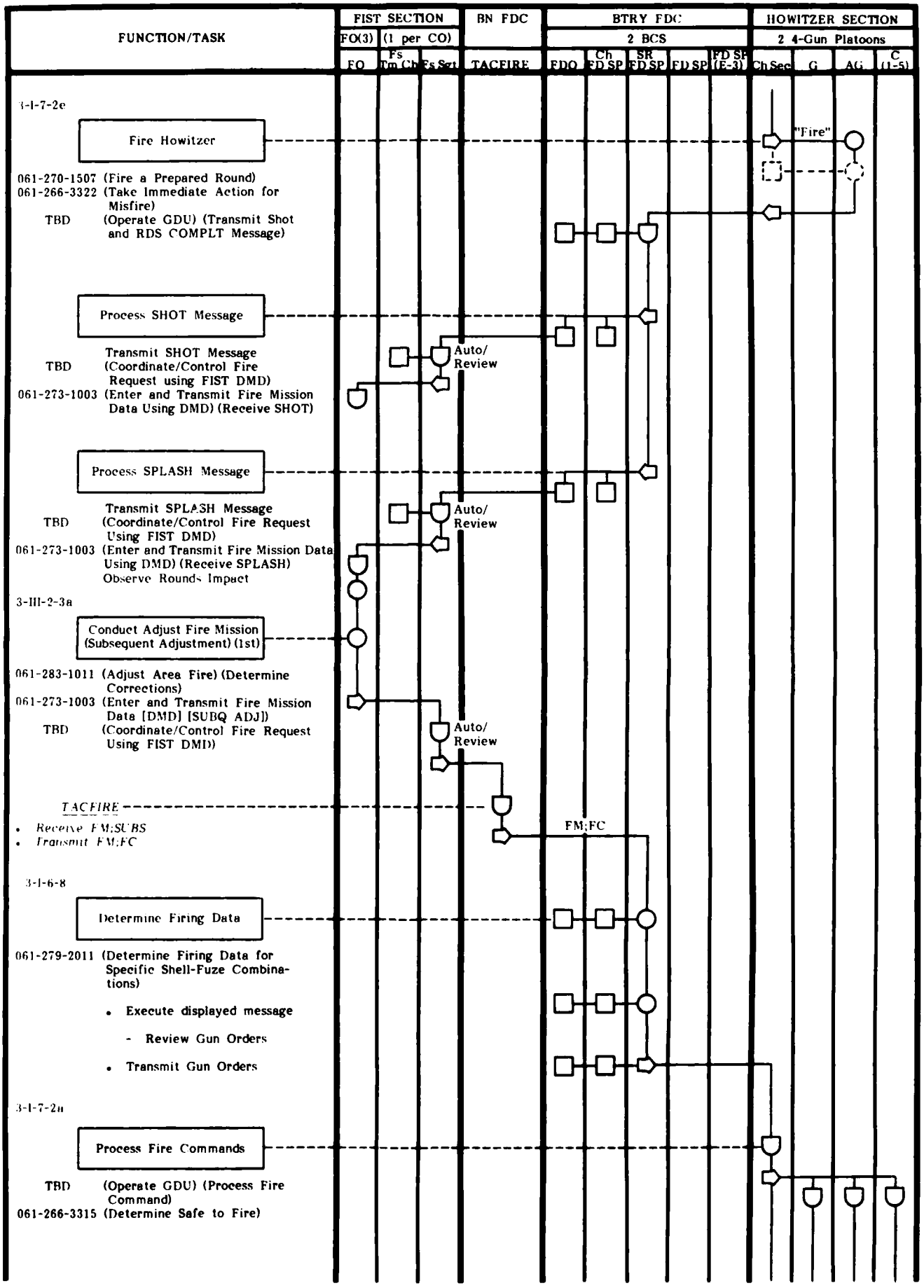
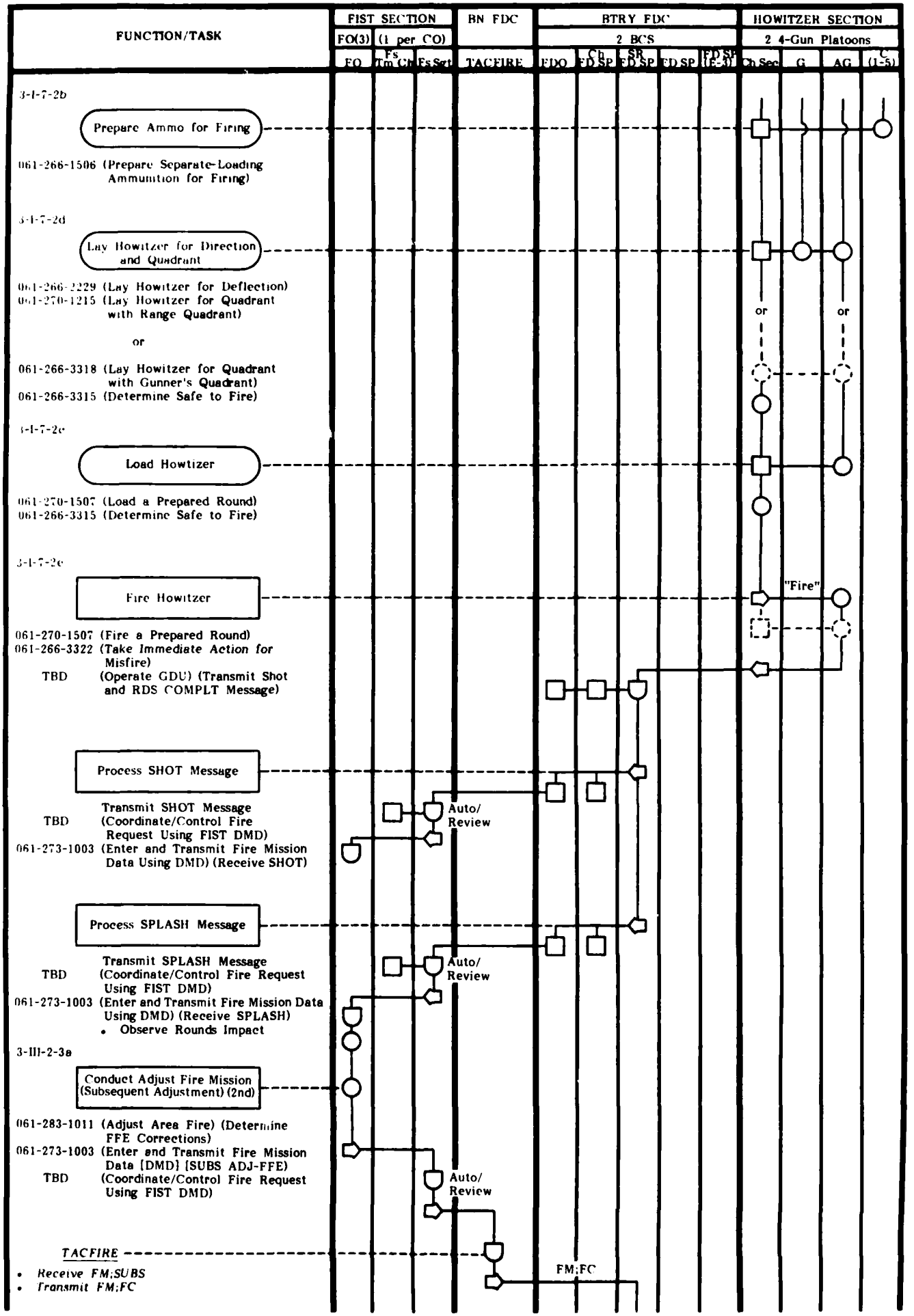
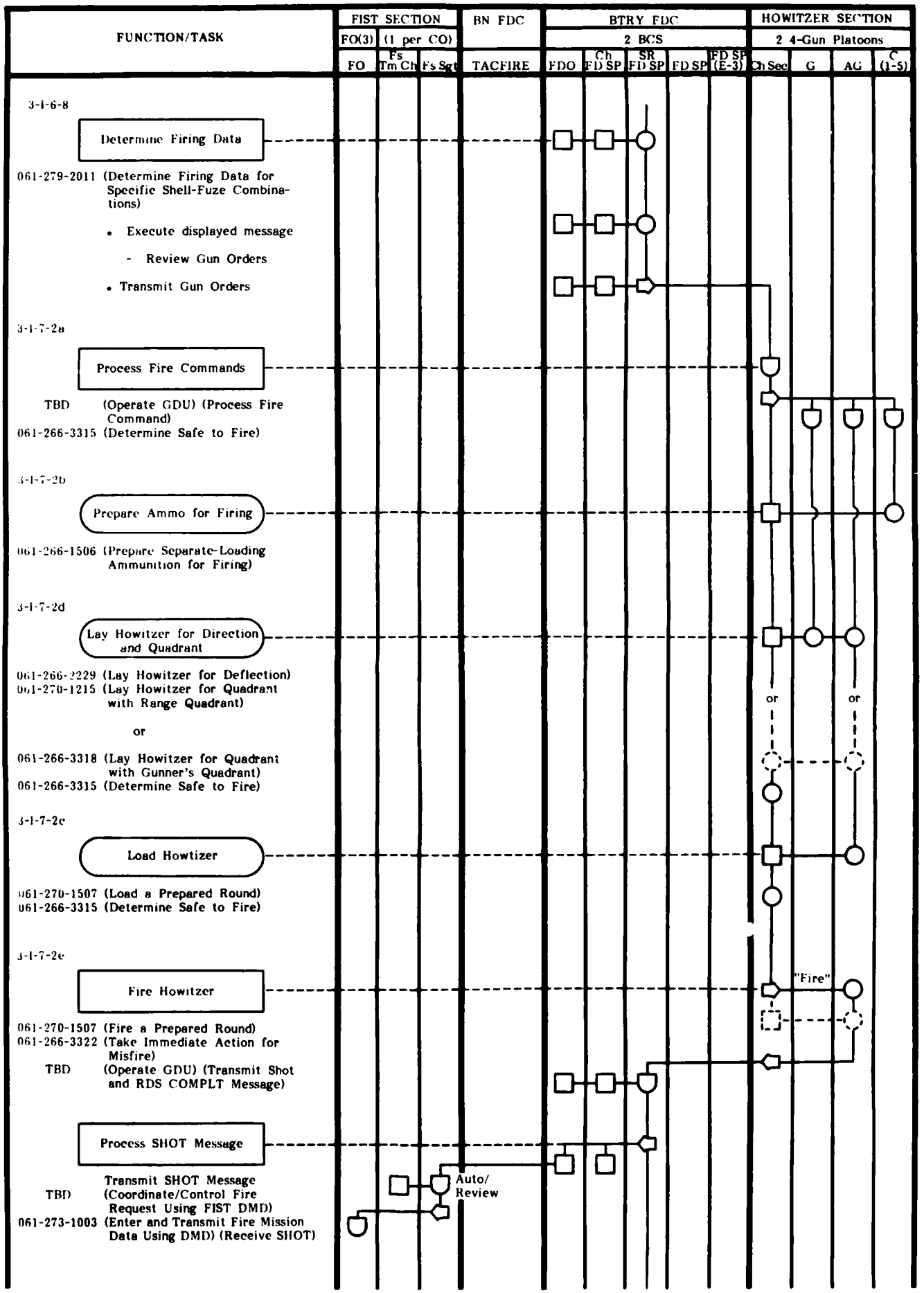


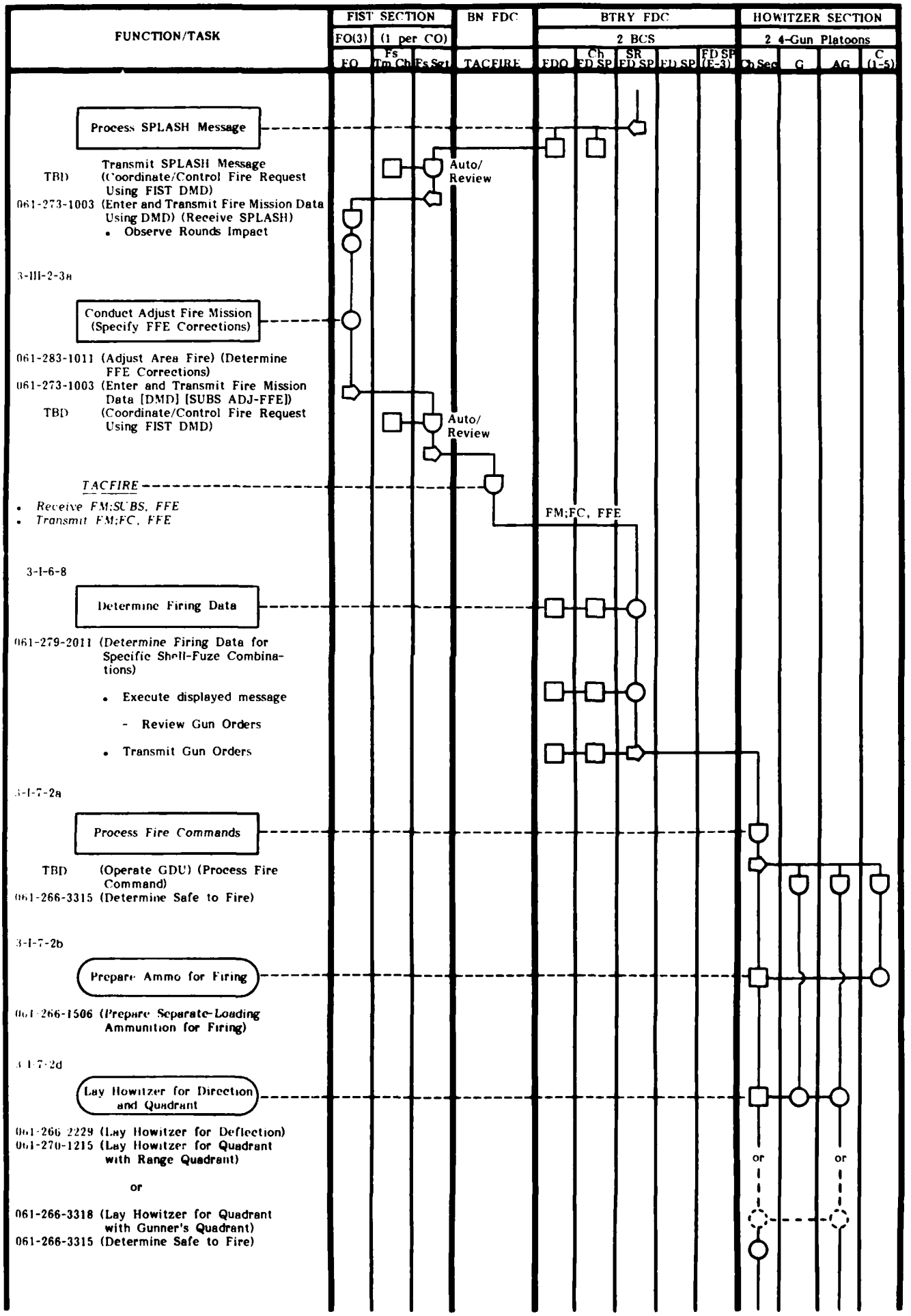
Figure A-3. Low Angle, Adjust Fire Mission, When Ready (WR), Non-Autonomous.

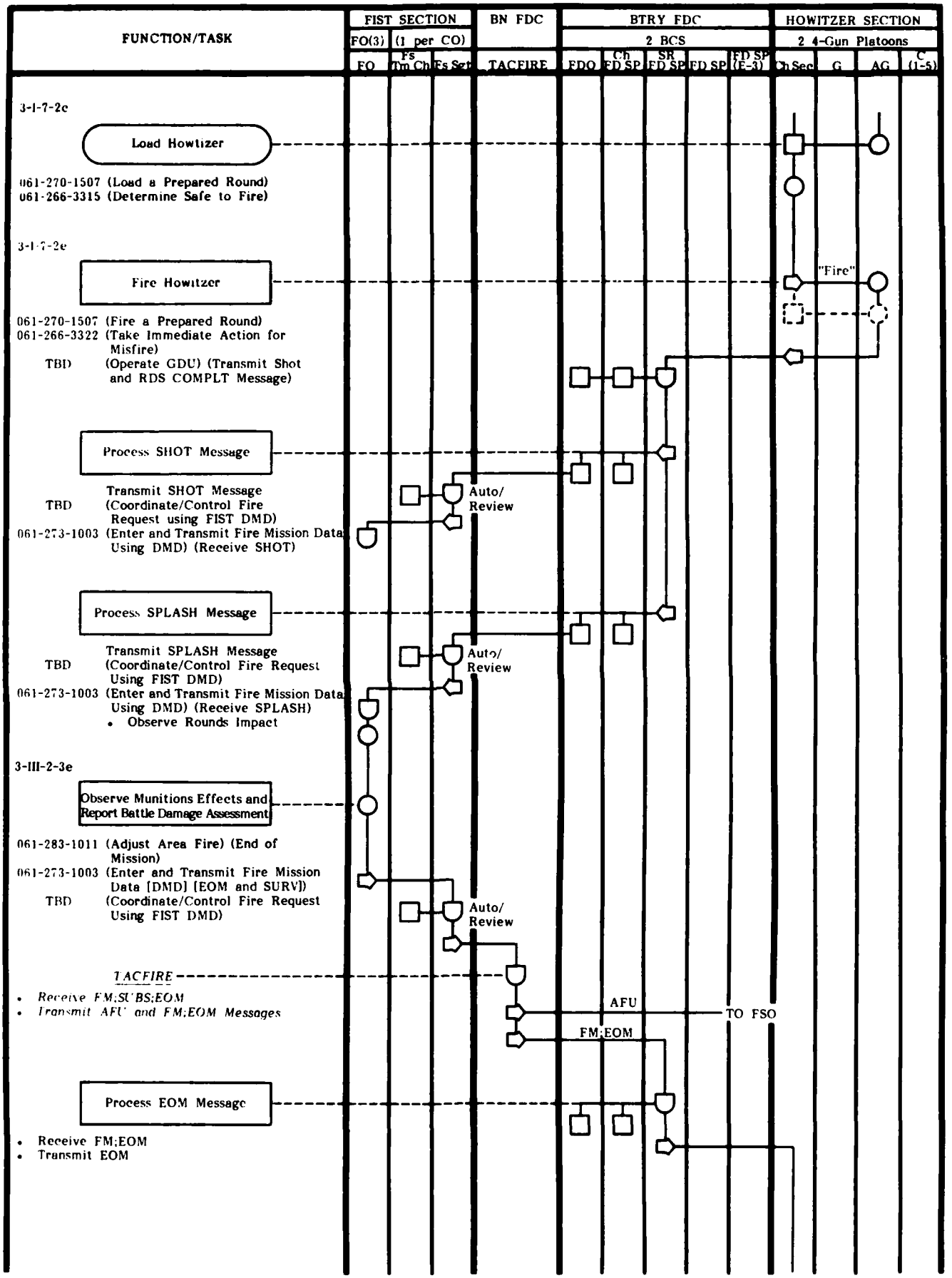

FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (C-4)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-8
Determine Firing Data
061-279-2002 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Grid Co-ordinates)
or
061-279-2003 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Polar Plot)
or
061-279-2004 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Shift from a Known Point)
or
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)

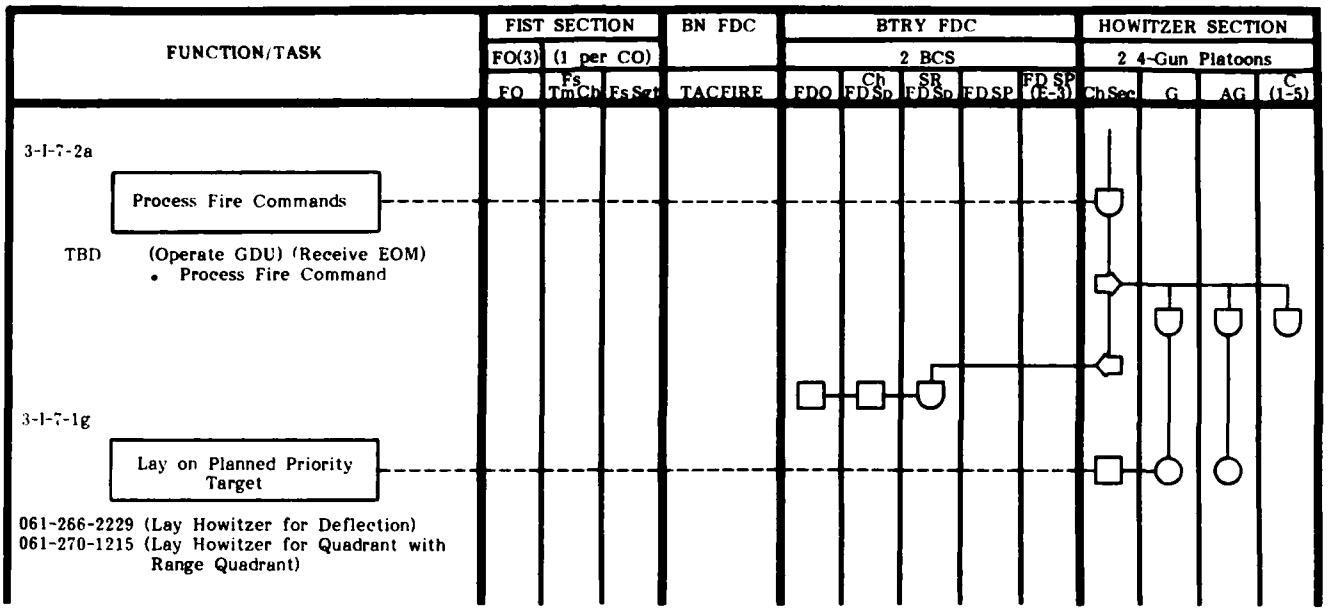

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
Observe Rounds Impact
Auto/ Review
3-III-2-3a
Conduct Adjust Fire Mission (Subsequent Adjustment) (1st)
061-283-1011 (Adjust Area Fire) (Determine Corrections)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [SUBQ ADJ])
TBD (Coordinate/Control Fire Request Using FIST DMD))
Auto/ Review
TACFIRE
• Receive FM;SUBS
• Transmit FM;FC
FM;FC
3-I-6-8
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)


FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BC'S
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-5)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-I-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3a
Conduct Adjust Fire Mission (Subsequent Adjustment) (2nd)
061-283-1011 (Adjust Area Fire) (Determine FFE Corrections)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [SUBS ADJ-FFE)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
TACFIRE
• Receive FM;SUBS
• Transmit FM;FC
FM;FC


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-8
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2c
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-1-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
3-III-2-3a
Conduct Adjust Fire Mission (Specify FFE Corrections)
061-283-1011 (Adjust Area Fire) (Determine FFE Corrections)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [SUBS ADJ-FFE])
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
TACFIRE
• Receive FM;SUBS, FFE
• Transmit FM;FC, FFE
FM;FC, FFE
3-I-6-8
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2c
Load Howitzer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3e
Observe Munitions Effects and Report Battle Damage Assessment
061-283-1011 (Adjust Area Fire) (End of Mission)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [EOM and SURV])
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
TACFIRE
• Receive FM;SUBS;EOM
• Transmit AFU and FM;EOM Messages
AFU
TO FSO
FM;EOM
Process EOM Message
• Receive FM;EOM
• Transmit EOM


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD Sp
SR FD Sp
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-7-2a
Process Fire Commands
TBD
(Operate GDU) (Receive EOM)
• Process Fire Command
3-1-7-1g
Lay on Planned Priority Target
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)

2. Low Angle, Adjust Fire, AMC, Autonomous

This fire mission is shown in Figure A-4 on the following page. The mission is autonomous since it is not under battalion TACFIRE control. In the autonomous role, the battery FDC performs both the tactical and technical fire direction to determine the gunnery solution. In the previous example, adjust fire, non-autonomous, the battalion FDC TACFIRE provided the tactical gunnery solution, and the battery FDC via the BCS provided the technical solution, i.e., the Fire Command (gun orders) to the howitzer section. The term "at my command (AMC)" is a special instruction requested by the observer which restricts the howitzer section from firing until the "Fire" message is transmitted by the observer.

The "Locate Target" function is initiated by the observer by performing one of the supporting SM tasks. The reader will note that the sequential flow of tasks for this function, "Conduct Adjust Fire Missions" and "Monitor/Process Request for Immediate Fire Support" functions are essentially the same as the non-autonomous, adjust fire mission. In processing the fire mission, the battery FDC performs the following functions: 3-I-6-8b, Coordinate/Control Adjust Fire Missions; 3-I-6-7a, Determine Method of Attack; 3-I-6-7b, Issue Battery Fire Order; and 3-I-6-8, Determine Firing Data. The BCS operator transmits the RFAF message to the FSO, the gun orders to the howitzer section and the Message to Observer (MTO) to the observer. The howitzer section performs the following functions in executing the gun orders: 3-I-7-2a, Process Fire Commands; 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Direction and Quadrant; and 3-I-7-2c, Load Howitzer. The howitzer section transmits that they are ready to fire to the battery FDC. The battery FDC transmits the READY message to the observer. The observer then transmits the FIRE message to the howitzer section. The howitzer section fires and transmits the SHOT and ROUNDS COMPLETE message to the battery FDC. The battery FDC responds by transmitting the SHOT and, when appropriate, the SPLASH messages. Once the observer determines the subsequent adjustment data, he transmits the SUBS ADJ message to the battery FDC and the functions performed by both the Battery FDC and Howitzer Sections are repeated as previously described. After the howitzer section has completed the FFE phase of the mission, the observer performs function 3-III-2-3c, Observe Munition Effects and Report Battle Damage Assessment, and transmits EOM to the battery FDC. The battery FDC transmits a FM;SUBS message to the FSO and an EOM message to the howitzer section. The section acknowledges and ends the mission by performing function 3-I-7-1g, Lay on Priority Target.

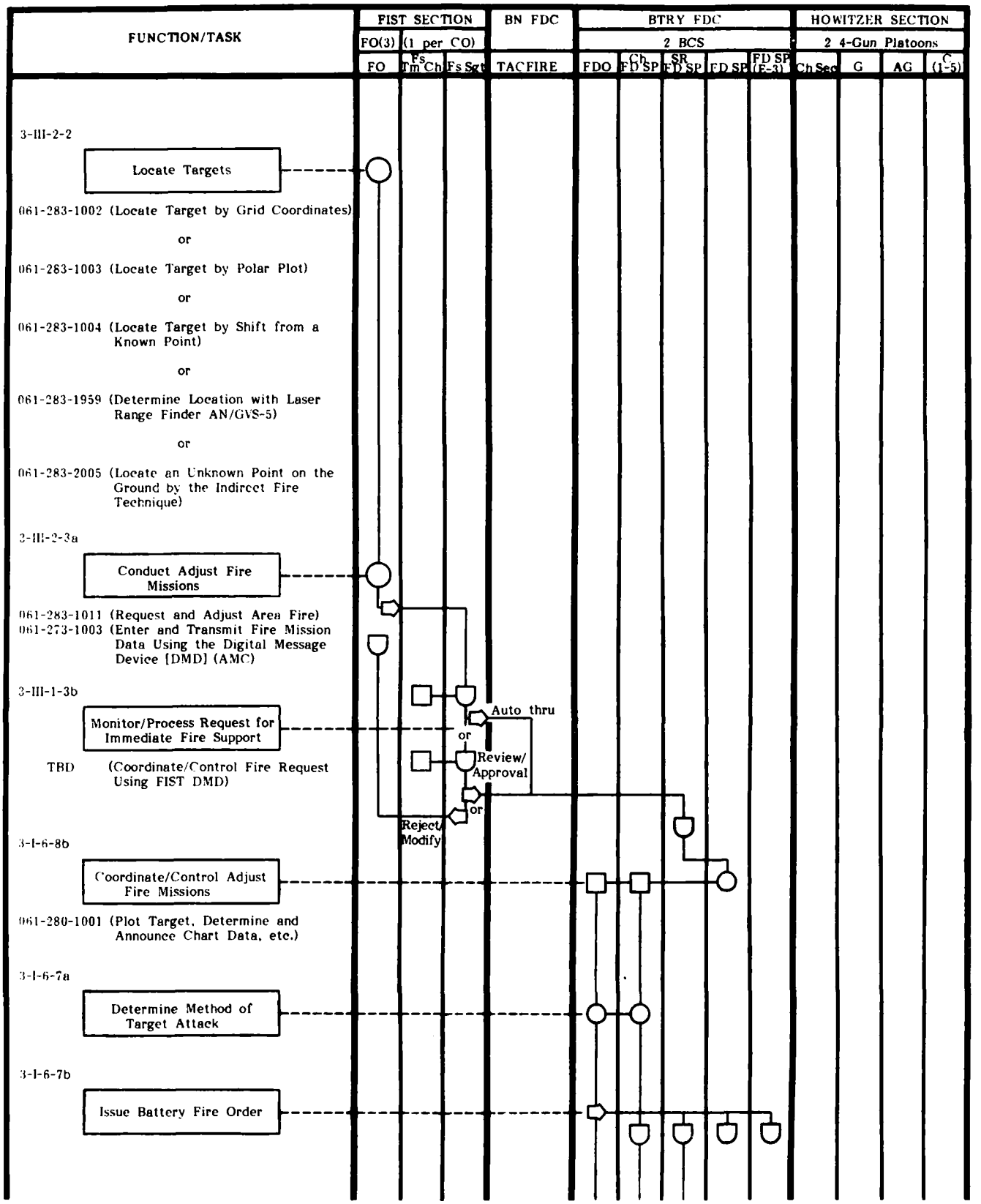
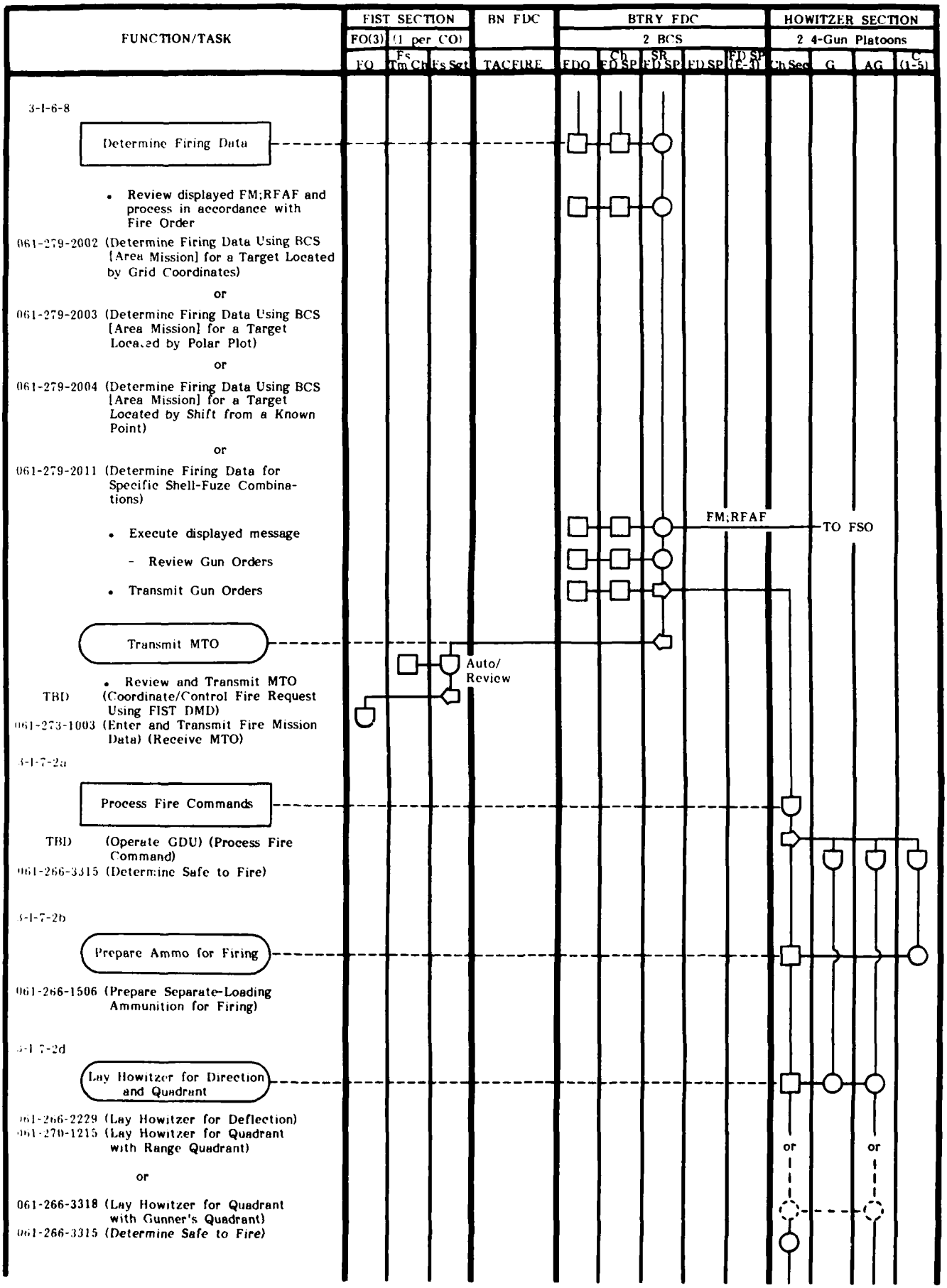
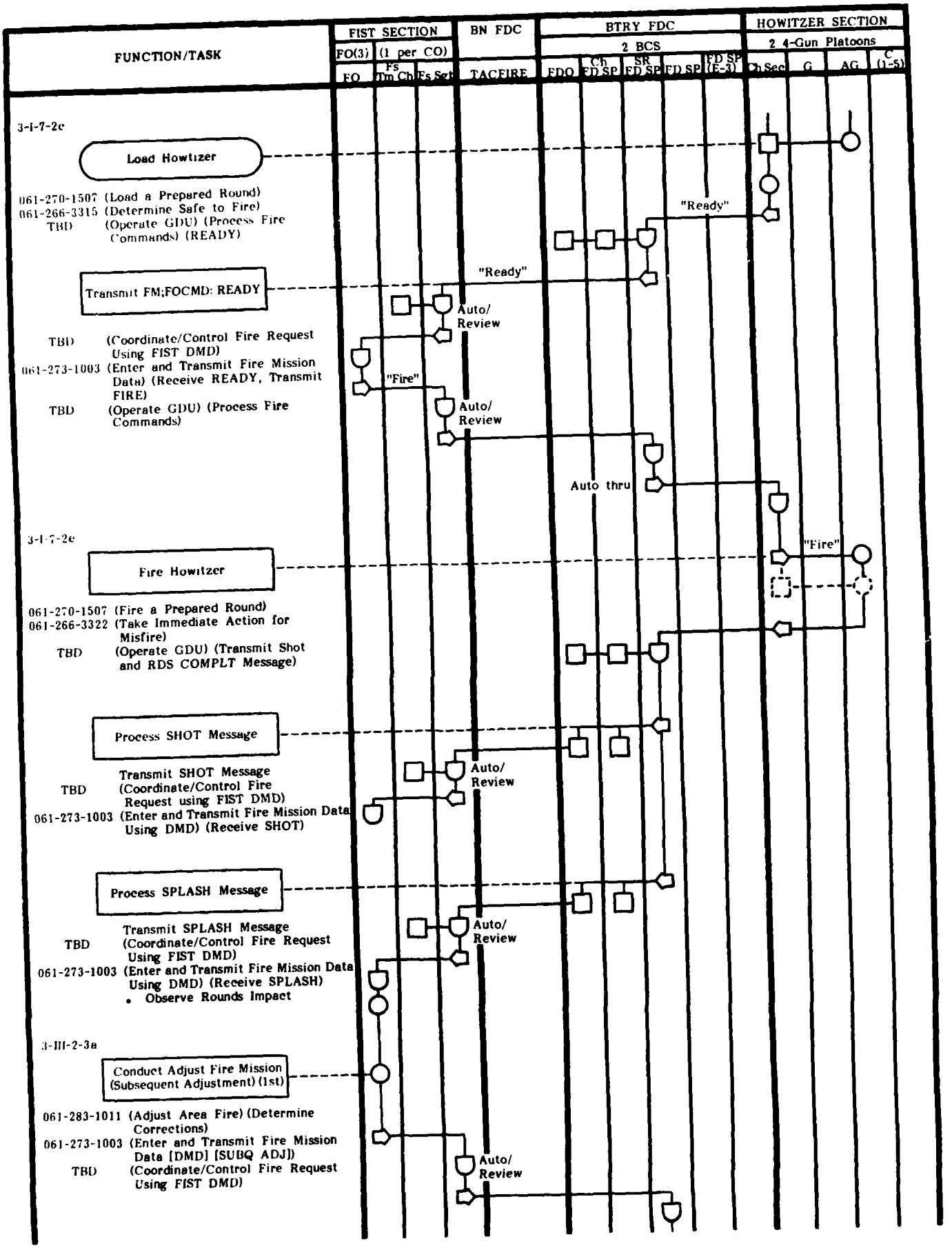
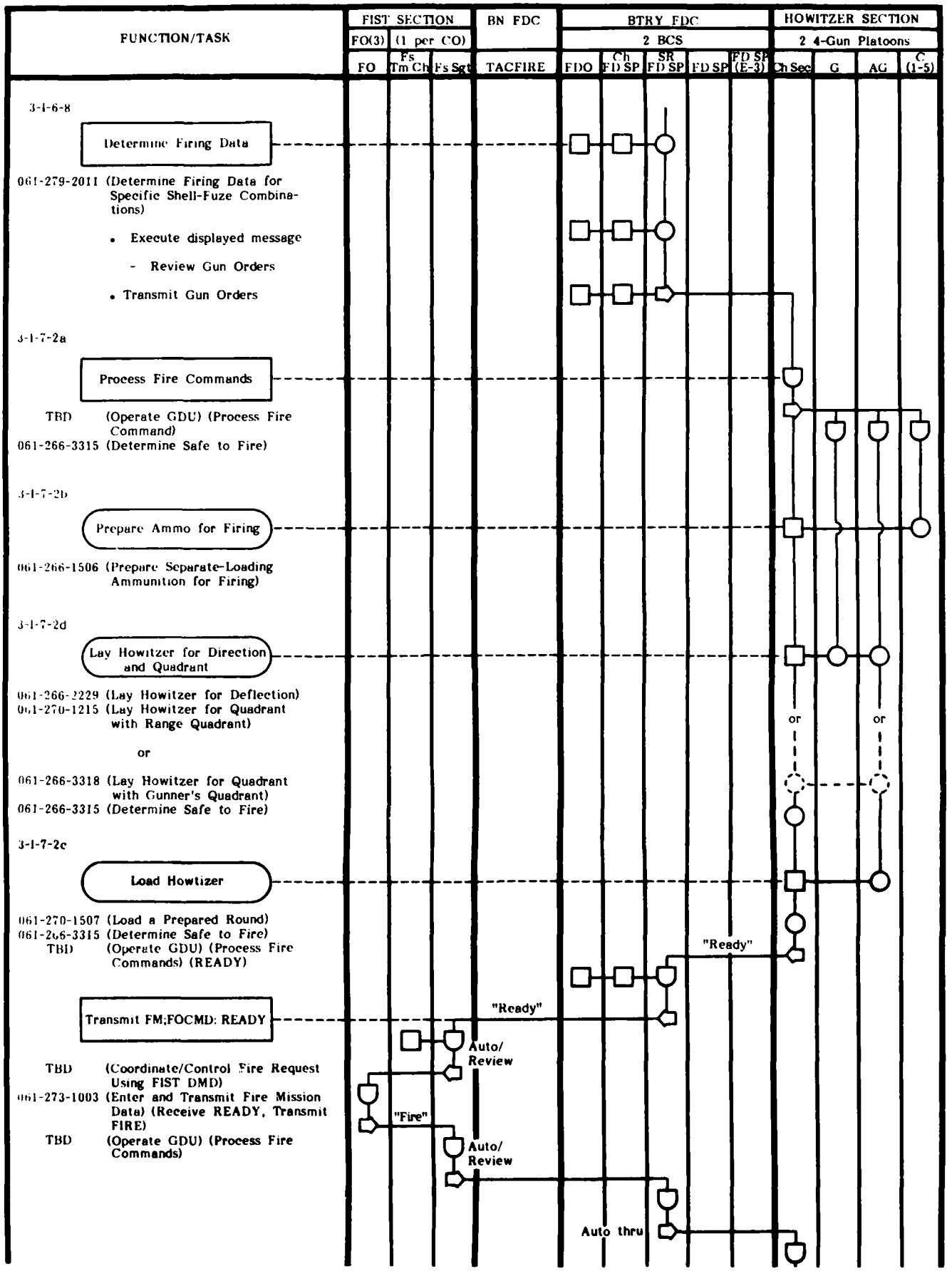
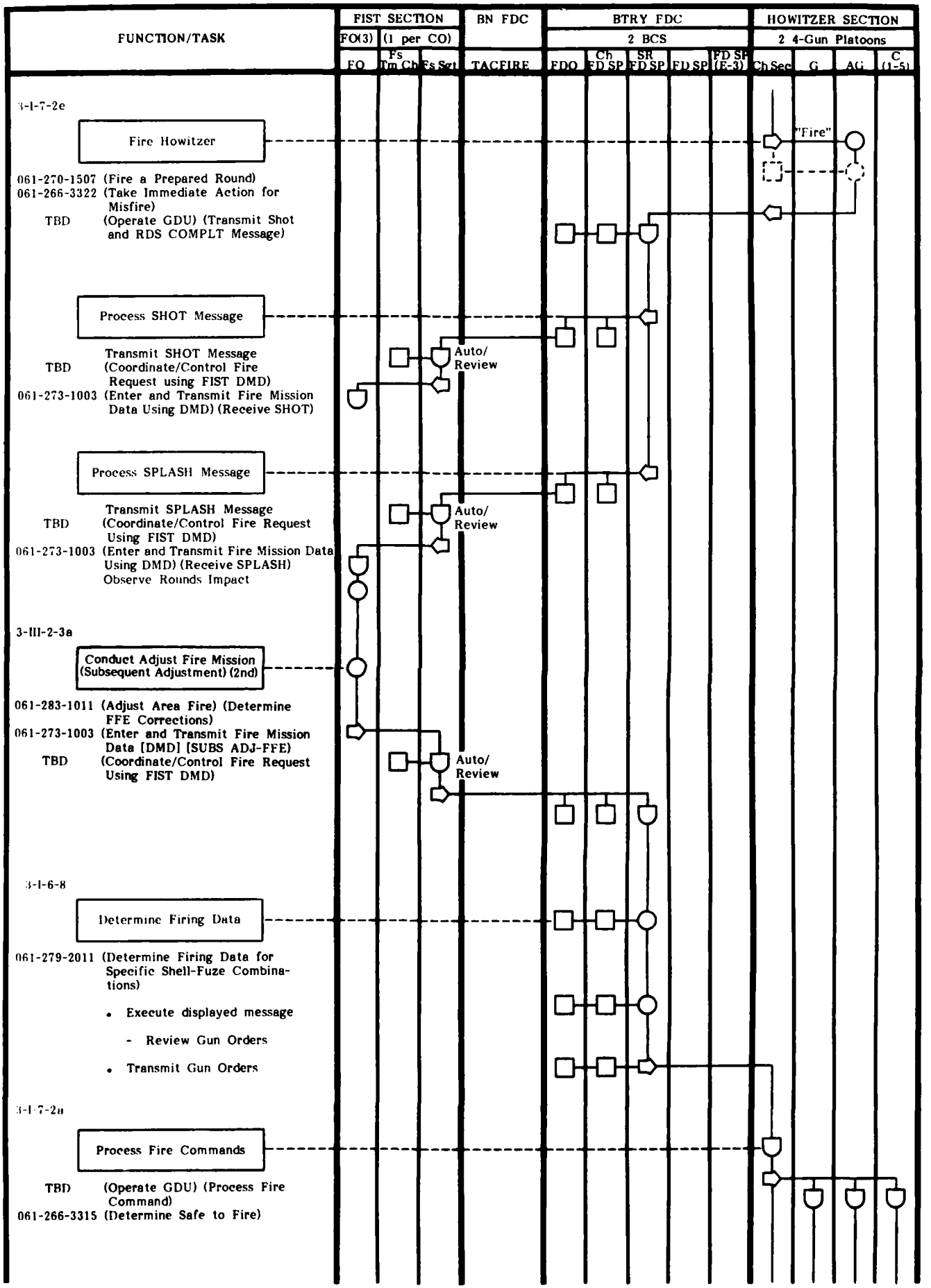


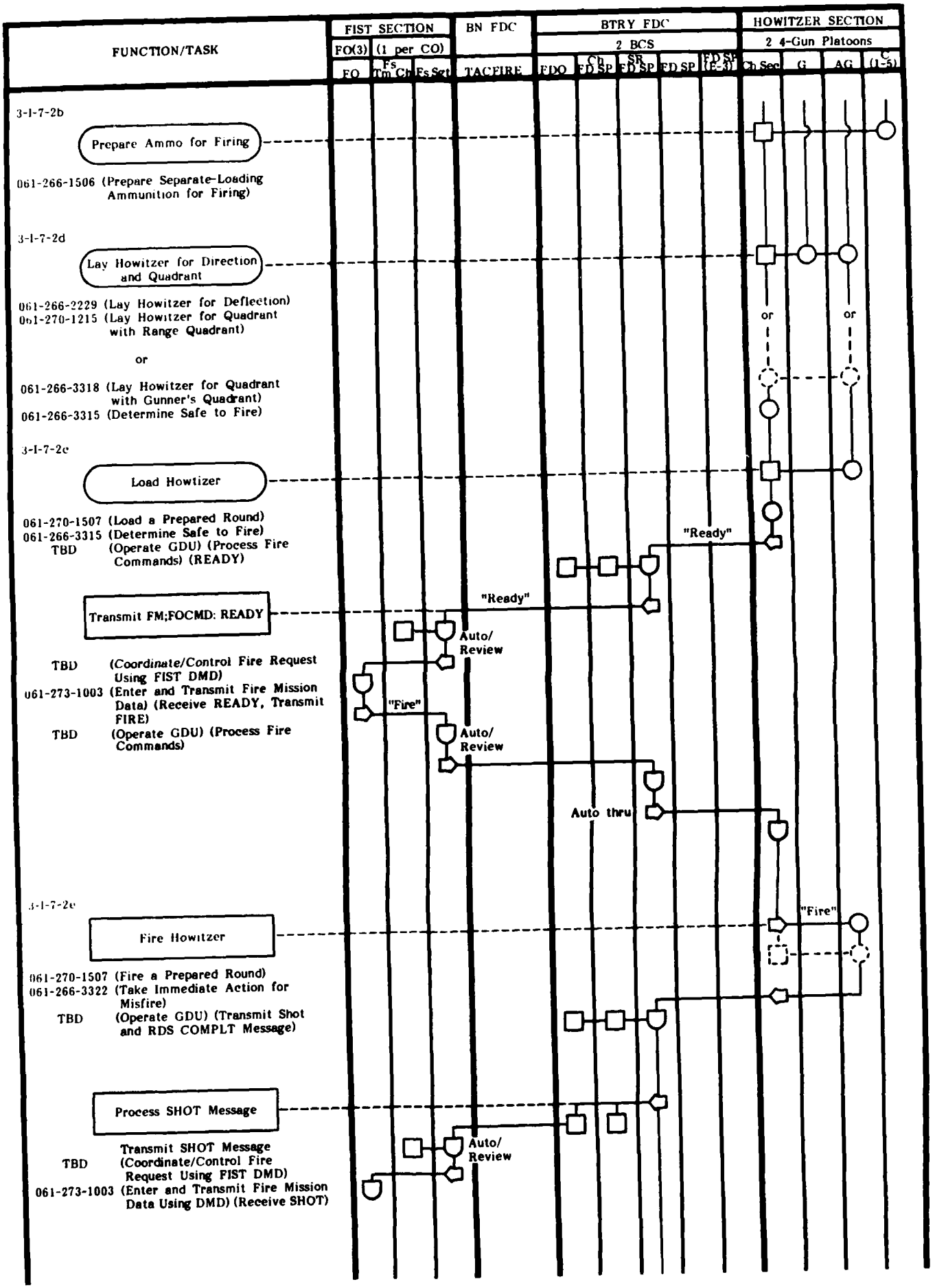
Figure A-4. Low Angle, Adjust Fire Mission, At My Command (AMC), Autonomous.

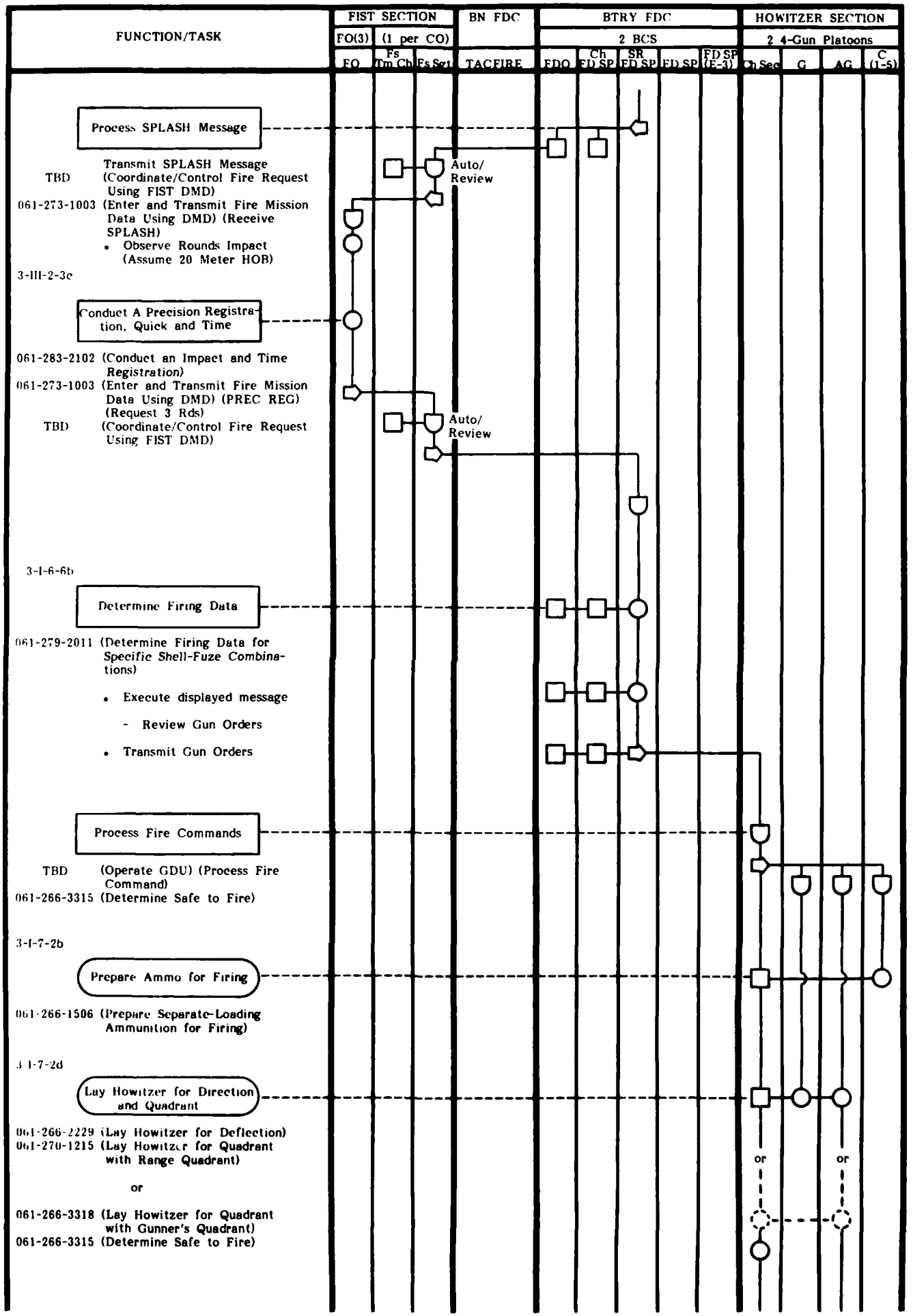

FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
FS Tm Ch
FS Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (C-E)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-8
Determine Firing Data
• Review displayed FM;RFAF and process in accordance with Fire Order
061-279-2002 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Grid Coordinates)
or
061-279-2003 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Polar Plot)
or
061-279-2004 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Shift from a Known Point)
or
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
FM;RFAF
TO FSO
Transmit MTO
Auto/ Review
• Review and Transmit MTO
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive MTO)
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or

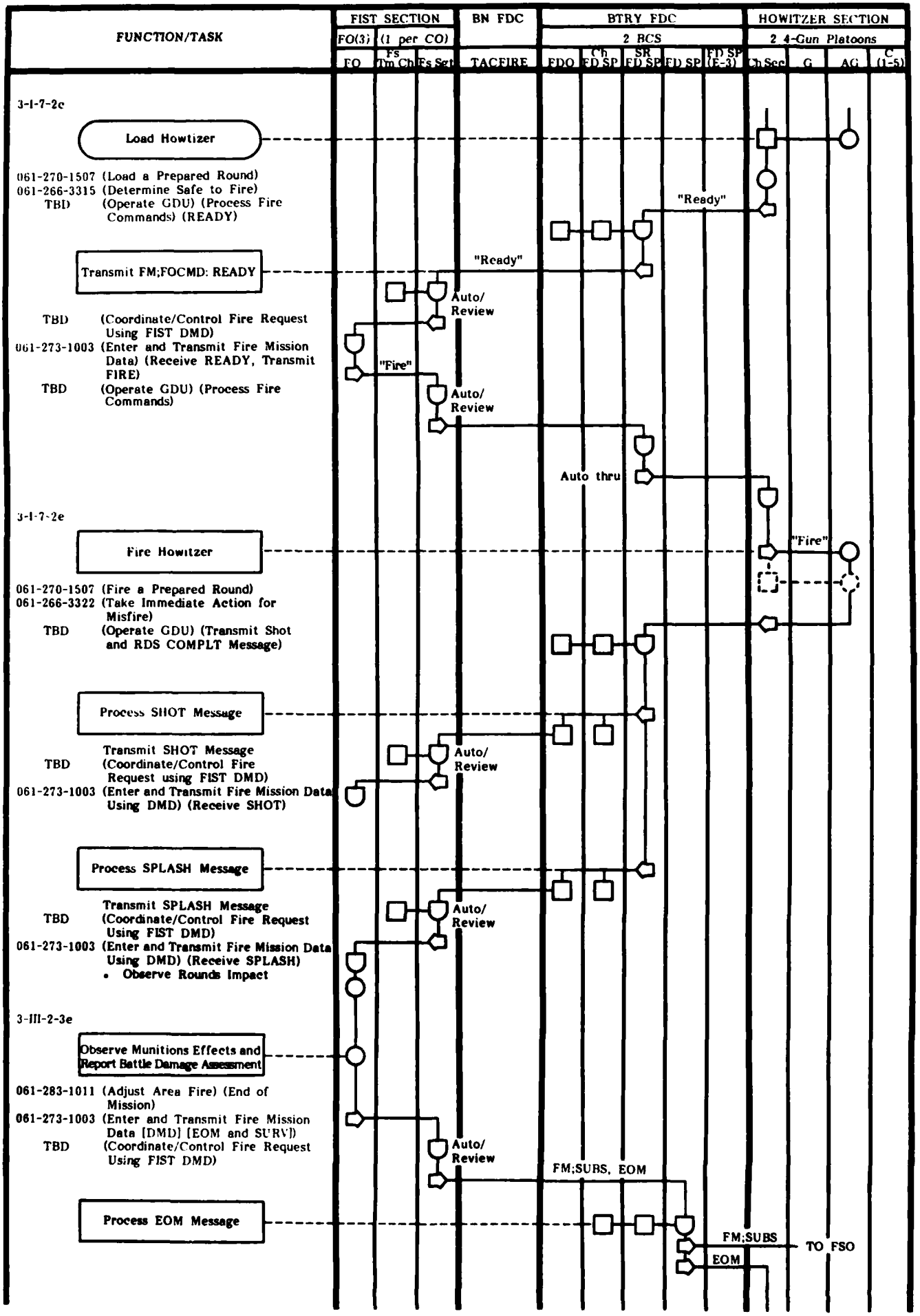

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm
Ch Fs Sct
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2c
Load Howitzer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
TBD (Operate GDU) (Process Fire Commands) (READY)
"Ready"
Transmit FM;FOCMD: READY
"Ready"
Auto/ Review
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive READY, Transmit FIRE)
"Fire"
TBD (Operate GDU) (Process Fire Commands)
Auto/ Review
Auto thru
3-I-7-2c
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3a
Conduct Adjust Fire Mission (Subsequent Adjustment) (1st)
061-283-1011 (Adjust Area Fire) (Determine Corrections)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [SUBQ ADJ])
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review

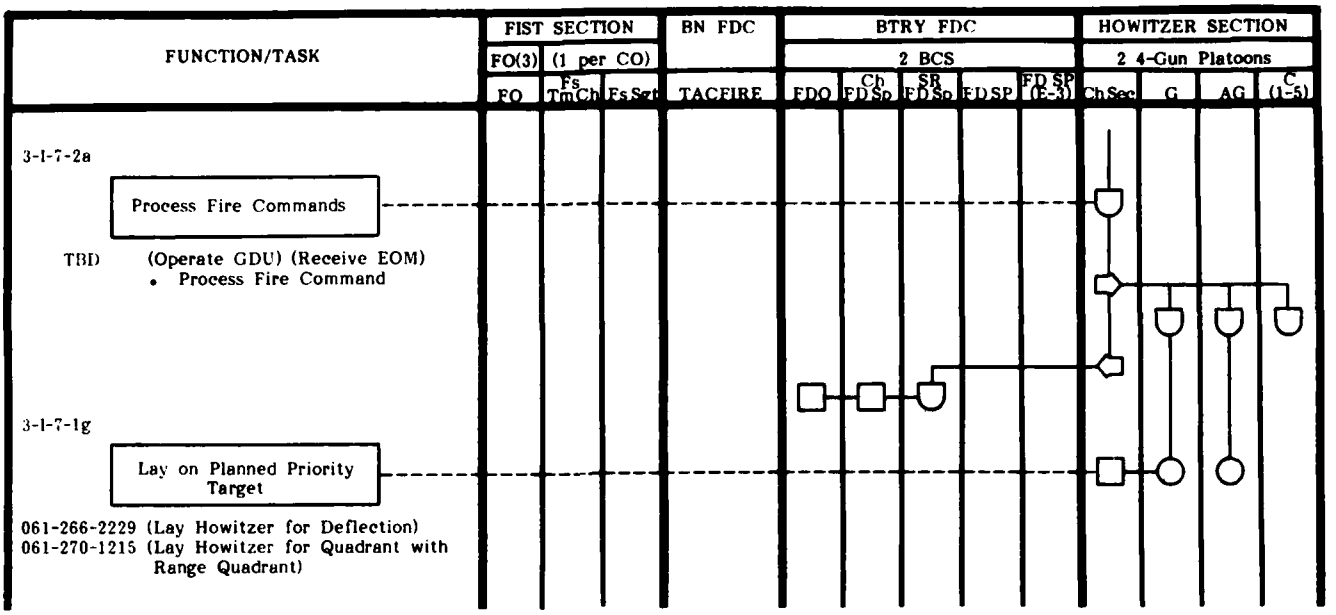

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-8
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2c
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
TBD (Operate GDU) (Process Fire Commands) (READY)
"Ready"
Transmit FM;FOCMD: READY
"Ready"
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive READY, Transmit FIRE)
TBD (Operate GDU) (Process Fire Commands)
Auto/ Review
"Fire"
Auto/ Review
Auto thru


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
FS Tm Ch
FS Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
Observe Rounds Impact
Auto/ Review
3-III-2-3a
Conduct Adjust Fire Mission (Subsequent Adjustment) (2nd)
061-283-1011 (Adjust Area Fire) (Determine FFE Corrections)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [SUBS ADJ-FFE)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
3-I-6-8
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Es Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
TBD (Operate GDU) (Process Fire Commands) (READY)
"Ready"
Transmit FM;FOCMD: READY
"Ready"
Auto/ Review
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive READY, Transmit FIRE)
"Fire"
TBD (Operate GDU) (Process Fire Commands)
Auto/ Review
Auto thru
3-1-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-4)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact (Assume 20 Meter HOB)
Auto/ Review
3-III-2-3c
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (Request 3 Rds)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
3-I-6-6b
Determine Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or


FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2c
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
TBD (Operate GDU) (Process Fire Commands) (READY)
"Ready"
Transmit FM;FOCMD: READY
"Ready"
Auto/ Review
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive READY, Transmit FIRE)
"Fire"
TBD (Operate GDU) (Process Fire Commands)
Auto/ Review
Auto thru
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3e
Observe Munitions Effects and Report Battle Damage Assessment
061-283-1011 (Adjust Area Fire) (End of Mission)
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [EOM and SURV])
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS, EOM
Process EOM Message
FM;SUBS
TO FSO
EOM


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sec
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD Sp
SR FD Sp
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-7-2a
Process Fire Commands
TBD
(Operate GDU) (Receive EOM)
• Process Fire Command
3-1-7-1g
Lay on Planned Priority Target
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)

3. Fire-for-Effect, Target of Opportunity, WR, Autonomous

This fire mission flow is depicted in Figure A-5 on the following page. The mission is assumed to be autonomous and is initiated by the observer by performing the "Locate Target" function. The target location may be determined by performing the supporting SM task or it may be known by a pre-determined target number, i.e., a target or area that has been previously fired upon and an accurate location has been determined; therefore, the location is known and a target number has been assigned. In performing function 3-III-2-3b, Conduct Fire-for-Effect Mission, the observer determines the type of FFE mission and transmits this fire request through the FIST Headquarters to the battery FDC. The fire mission is processed by the battery FDC by performing the following functions: 3-I-6-8d, Coordinate/Control Fire-for-Effect Missions; 3-I-6-7a, Determine Method of Target Attack; 3-I-6-7b, Issue Battery Fire Order; and 3-I-6-8, Determine Firing Data. As in all autonomous missions, the BCS operator transmits the RFAF message to the supported FSO, the gun orders to the howitzer section and the MTO to the observer. The howitzer section performs the following functions in executing the gun orders: 3-I-7-2a, Process Fire Commands; 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Direction and Quadrant; 3-I-7-2c, Load Howitzer; and 3-I-7-2e, Fire Howitzer. As the howitzers fire, they transmit SHOT. When the appropriate number of rounds have been fired, ROUNDS COMPLETE is also transmitted to the battery FDC. The battery FDC responds by transmitting the SHOT and, when appropriate, the SPLASH messages. The observer performs function 3-III-2-3c, Observe Munition Effects and Report Battle Damage Assessment, and transmits EOM to the battery FDC. The battery FDC transmits an FM;SUBS message to the FSO and an EOM message to the howitzer section. The section acknowledges and ends the mission by performing function 3-I-7-1g, Lay on Priority Target.

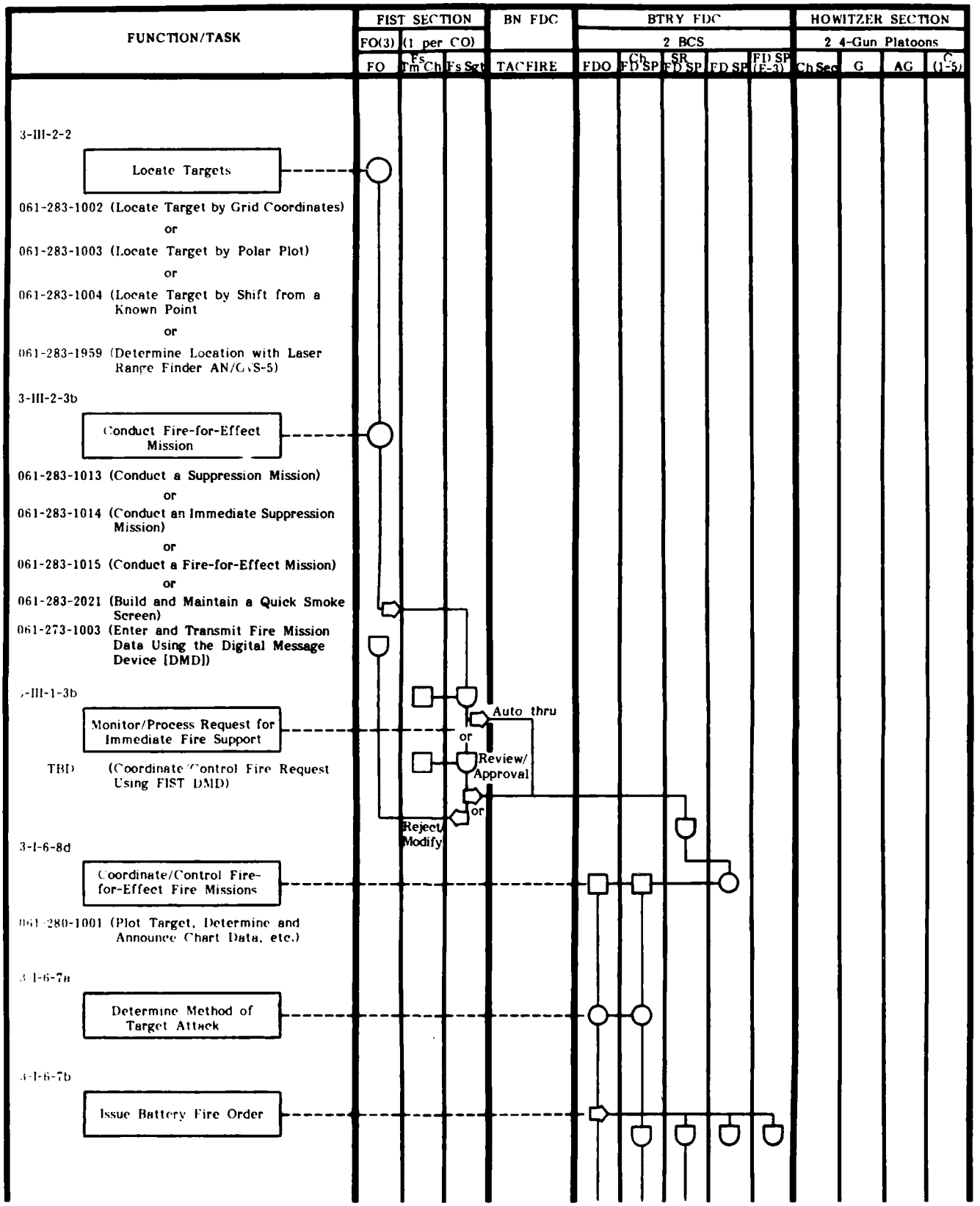
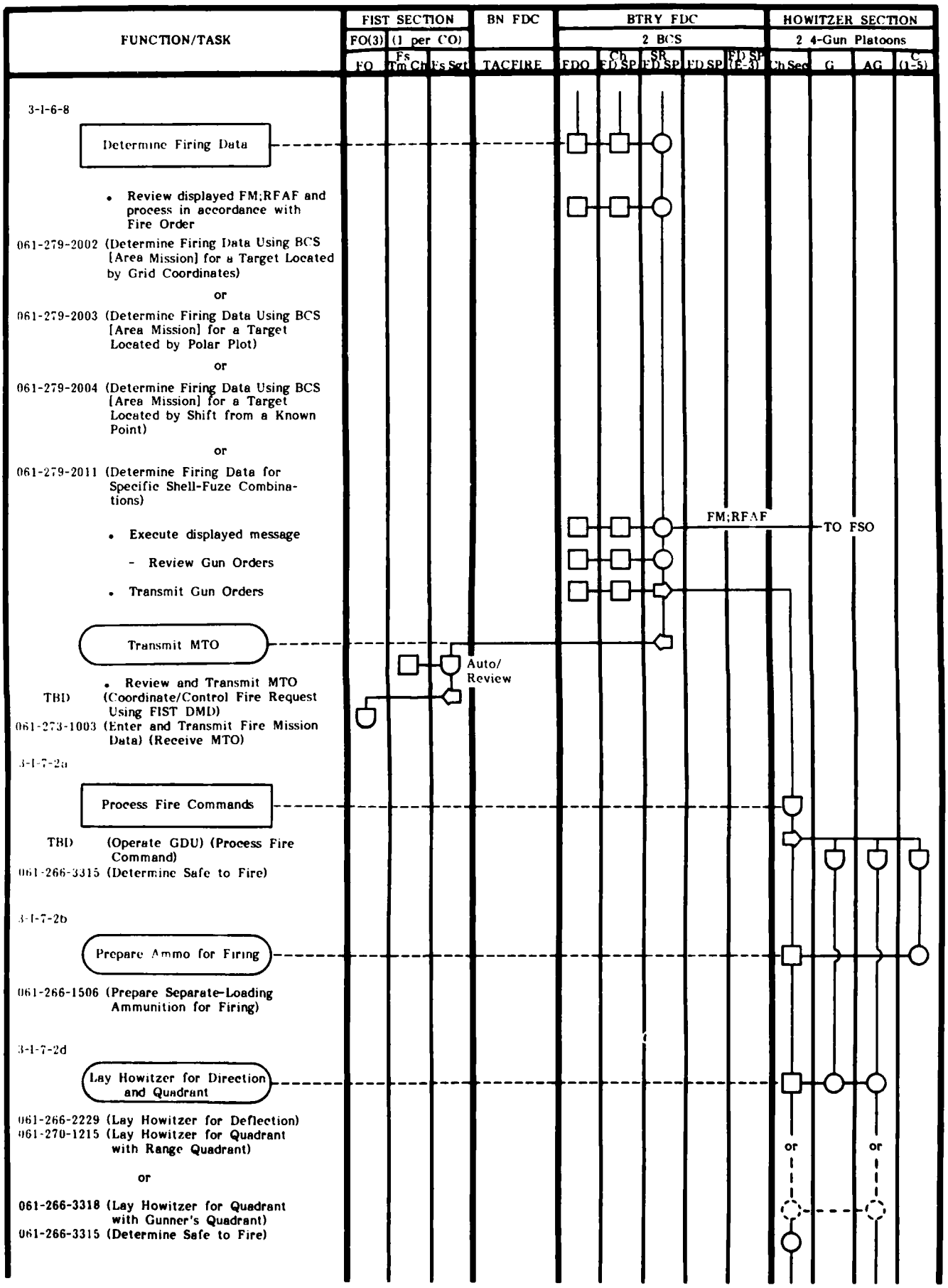
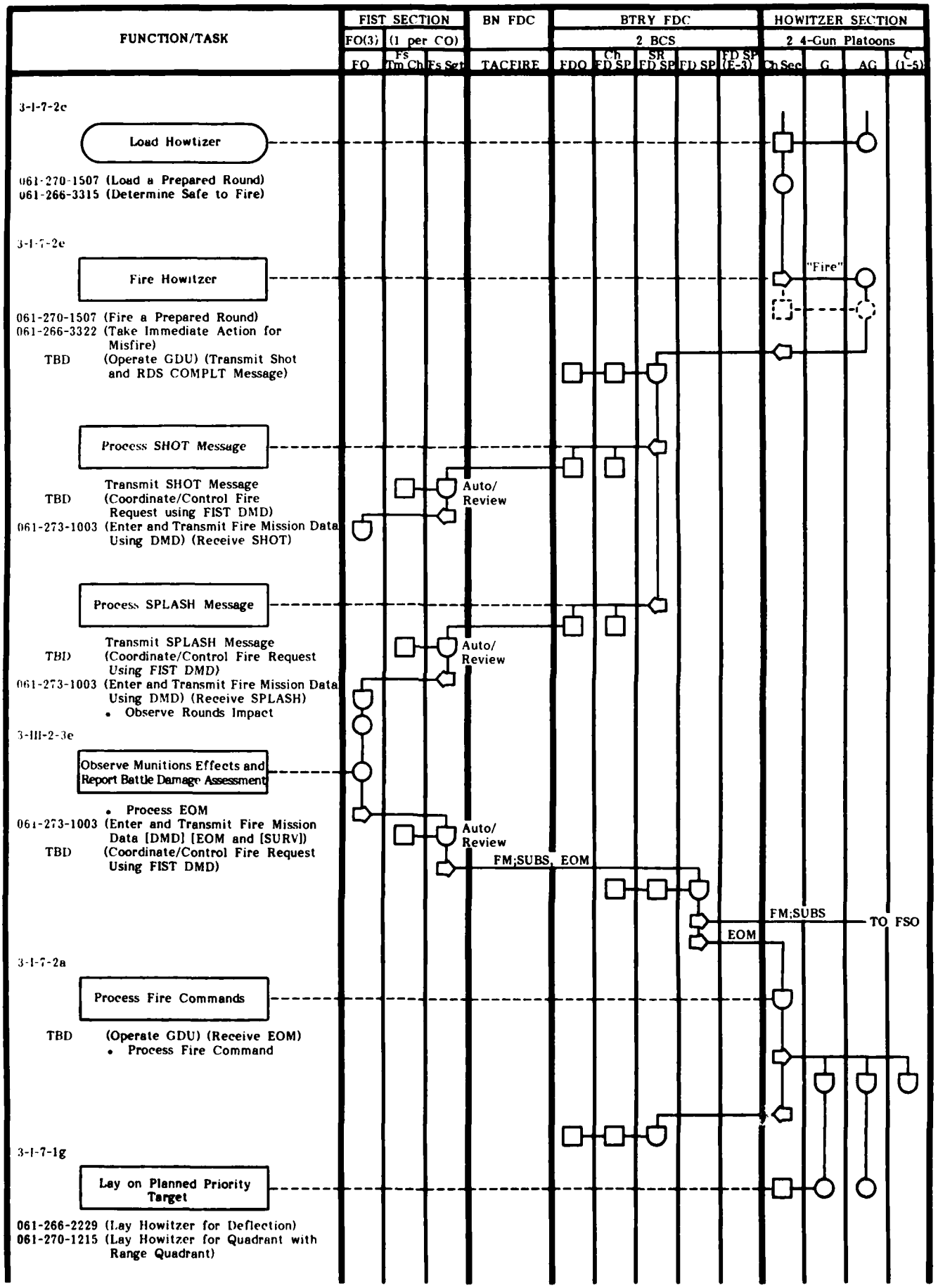


Figure A-5. Fire-for-Effect Mission, Target of Opportunity, When Ready (WR), Autonomous.


FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (O-5)
3-1-6-8
Determine Firing Data
• Review displayed FM;RFAF and process in accordance with Fire Order
061-279-2002 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Grid Coordinates)
or
061-279-2003 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Polar Plot)
or
061-279-2004 (Determine Firing Data Using BCS [Area Mission] for a Target Located by Shift from a Known Point)
or
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
FM;RFAF
TO FSO
Transmit MTO
Auto/ Review
• Review and Transmit MTO
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive MTO)
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or


FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sec
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2c
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3e
Observe Munitions Effects and Report Battle Damage Assessment
• Process EOM
061-273-1003 (Enter and Transmit Fire Mission Data [DMD] [EOM and [SURV])
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS, EOM
FM;SUBS
TO FSO
EOM
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Receive EOM)
• Process Fire Command
3-I-7-1g
Lay on Planned Priority Target
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)

4. Precision Registration, Quick and Time

This fire mission flow is illustrated in Figure A-6 on the following page. The precision registration is initiated with a registration alert message from the battery FDC (function 3-I-6-9a, Coordinate/Control Registrations) to the observer. In performing function 3-III-2-3c, Conduct a Precision Registration, Quick and Time, the observer determines the direction to the registration point and transmits a SYS;PTM message to the battery FDC indicating he is ready to conduct the registration. In performing function 3-I-6-6b, Determine Registration Data, the BCS operator selects the FM;RFAF message and enters and reviews the FDO specified data. Upon execution, the RFAF is transmitted to the FSO, the gun orders to the howitzer section and the MTO to the observer. The howitzer section performs the following functions in executing the gun orders: 3-I-7-2a, Process Fire Commands; 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Direction and Quadrant; 3-I-7-2c, Load Howitzer; and 3-I-7-2e, Fire Howitzer. Upon firing, a SHOT and ROUNDS COMPLETE message is transmitted to the battery FDC. The battery FDC responds by transmitting SHOT and, when appropriate, the SPLASH messages. The flow that follows illustrates observer, FDC and howitzer section interaction until the observer has achieved a 50 meter bracket and observed two rounds resulting in a range spotting of the opposite direction. This is assumed to have occurred with the third Adjustment. The observer transmit a PREC REG message stating RARP (record as registration point) and continues the mission by requesting a time registration (TIRPT). The battery FDC performs function 3-I-6-6b, Determine Registration Data, in determining the gun orders. A MTO is transmitted to the observer and the gun orders are transmitted to the howitzer section. In producing the fires, the howitzer section performs functions 3-I-7-2a, Process Fire Commands; 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Direction and Quadrant; 3-I-7-2c, Load Howitzer; and 3-I-7-2e, Fire Howitzer. The appropriate SHOT and ROUNDS COMPLETE message is transmitted to the battery FDC. The battery FDC transmits the SHOT and, when appropriate, the SPLASH messages to the observer. In this example, the height of burst (HOB) is determined to be 20 meters. The observer continues the mission by requesting three rounds in conducting function 3-III-2-3c, Conduct a Precision Registration, Time. The FDC and howitzer section functions are performed in providing the fire direction support and produce the howitzer fires. The observer ends the mission by transmitting the RATI;EOM (record as time, end of mission) messages. The battery FDC performs function 3-I-6-6b, Determine Registration Firing Data, and transmits appropriate messages to TACFIRE, FSO and the howitzer section. Upon receipt of EOM, the howitzer section acknowledges and performs function 3-I-7-1g, Lay on Planned Priority Target.

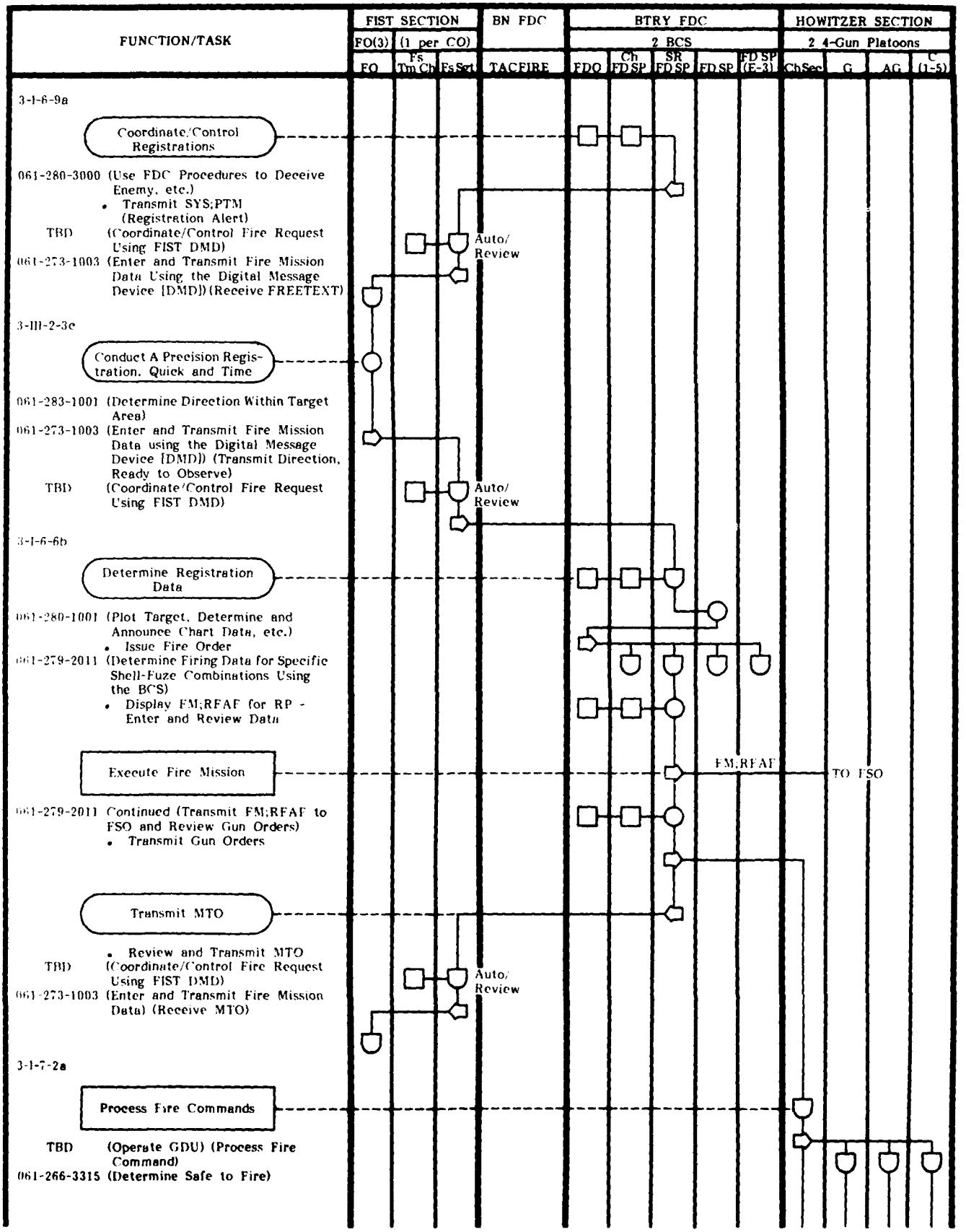
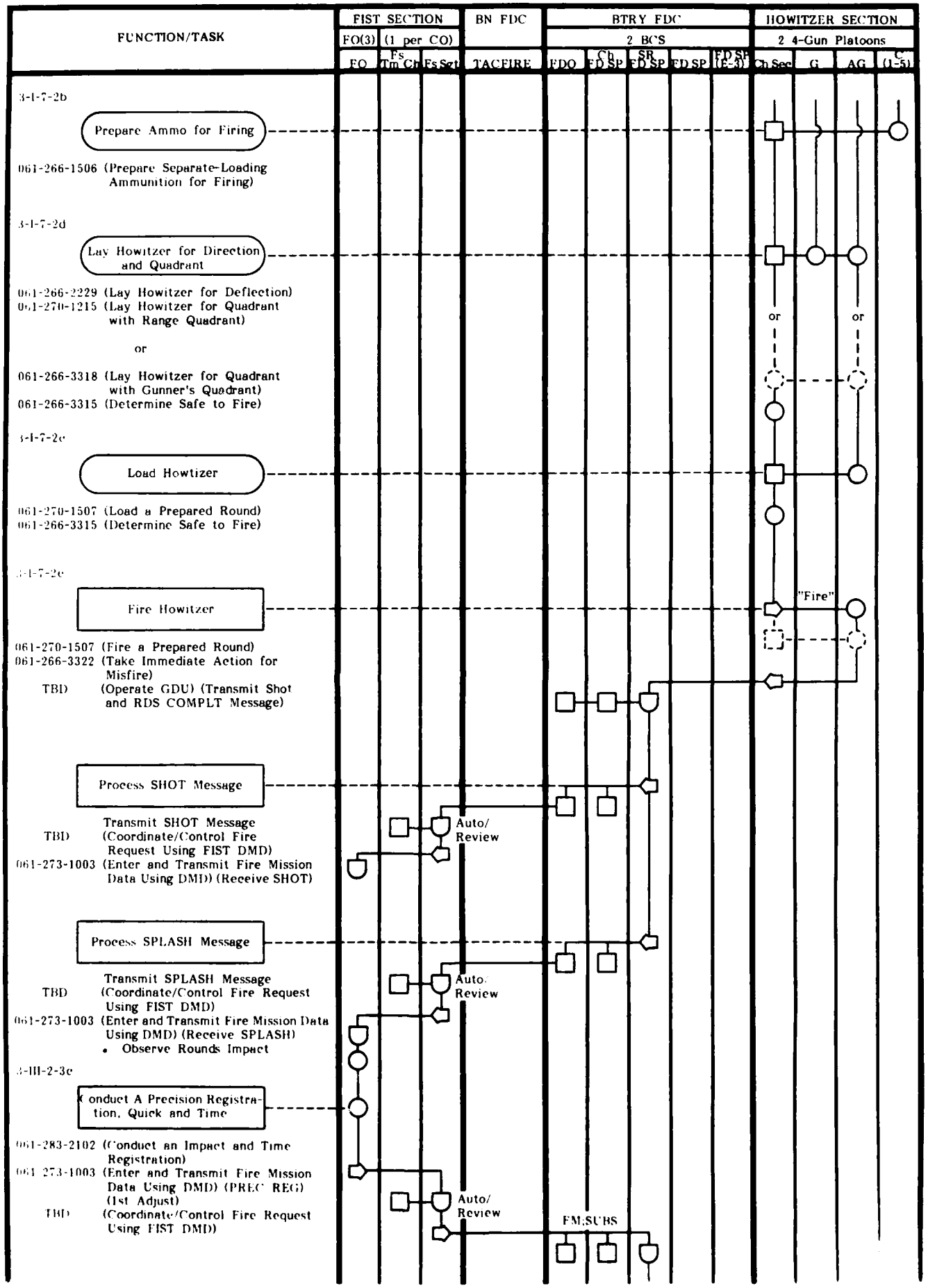
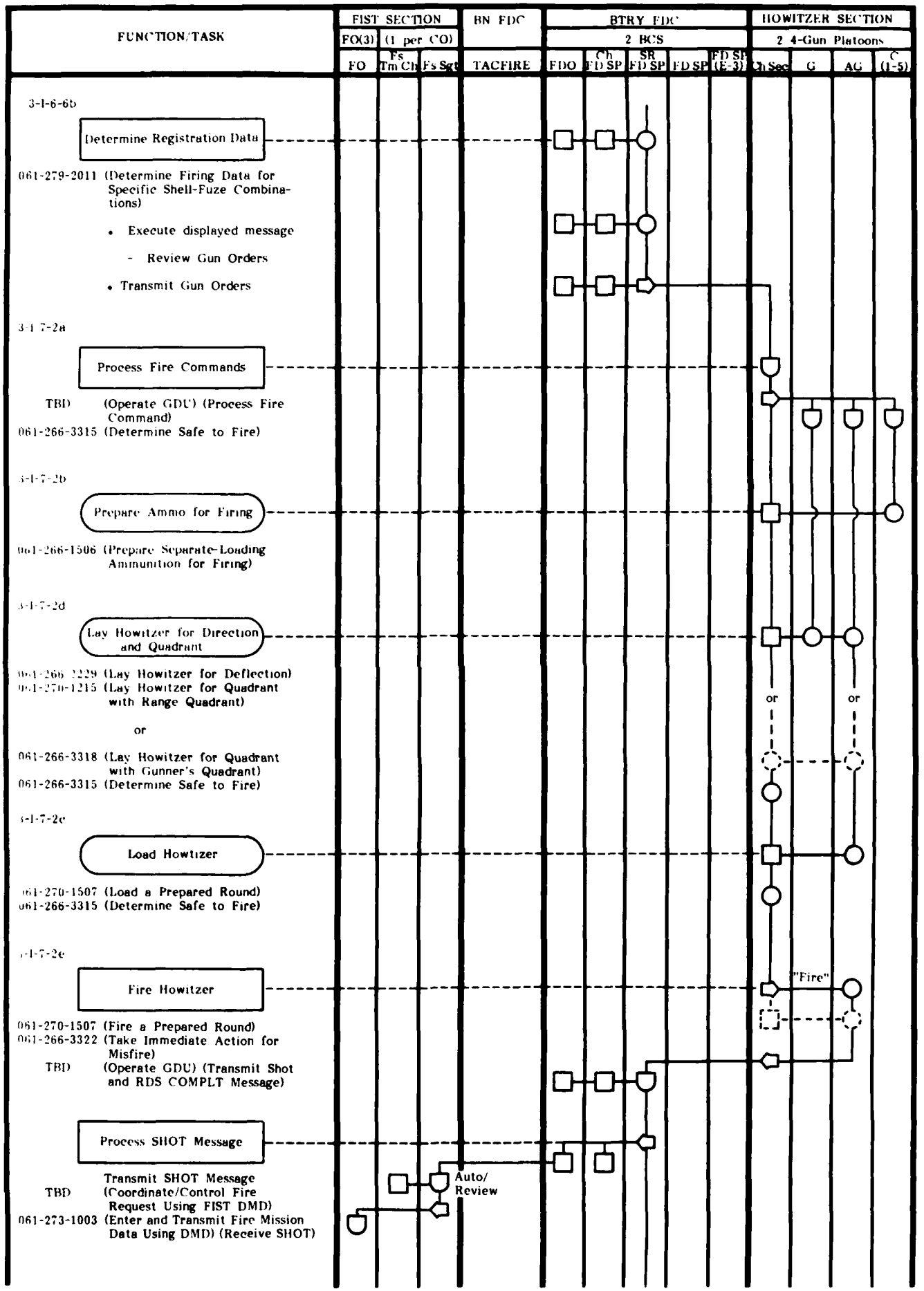
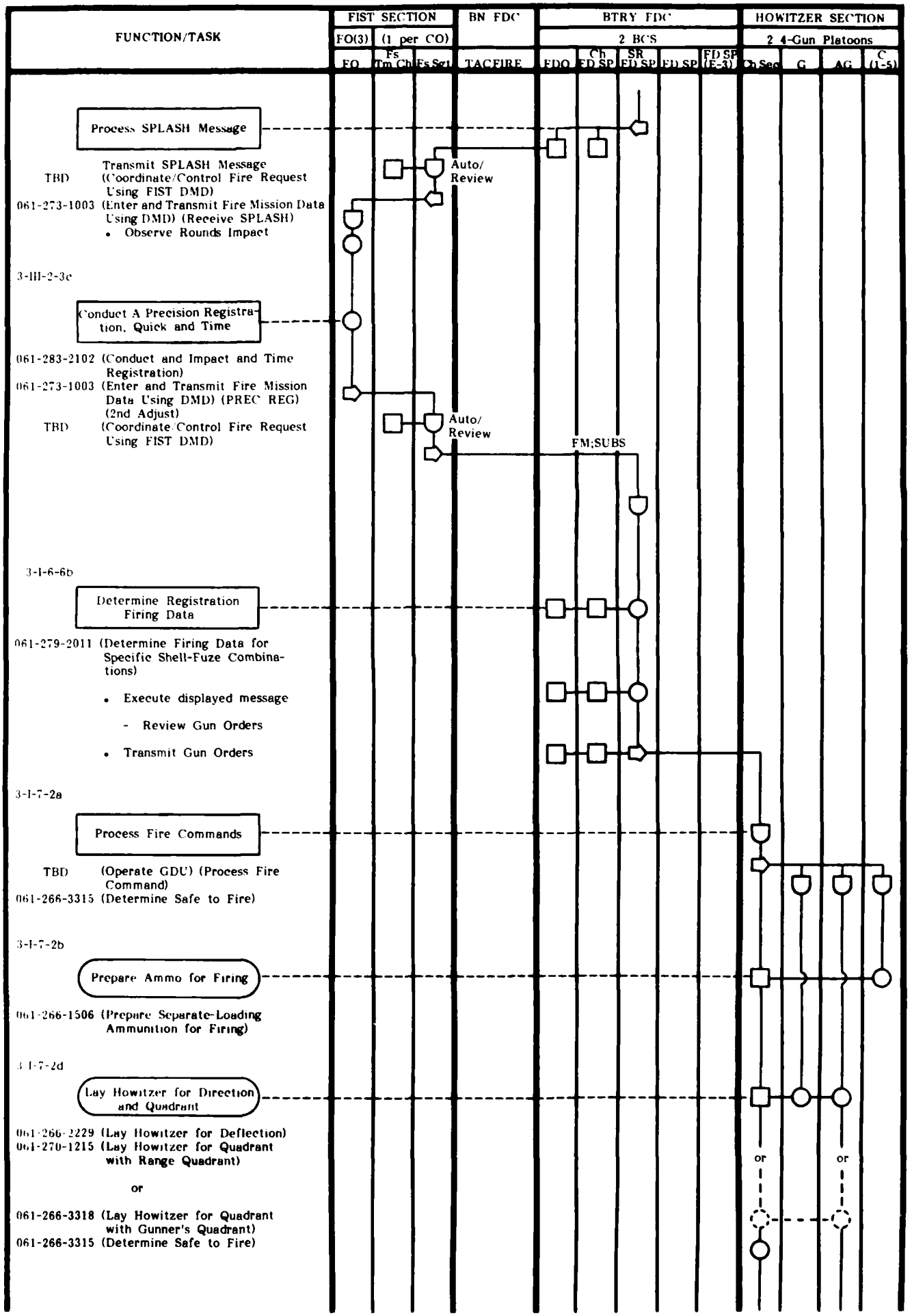
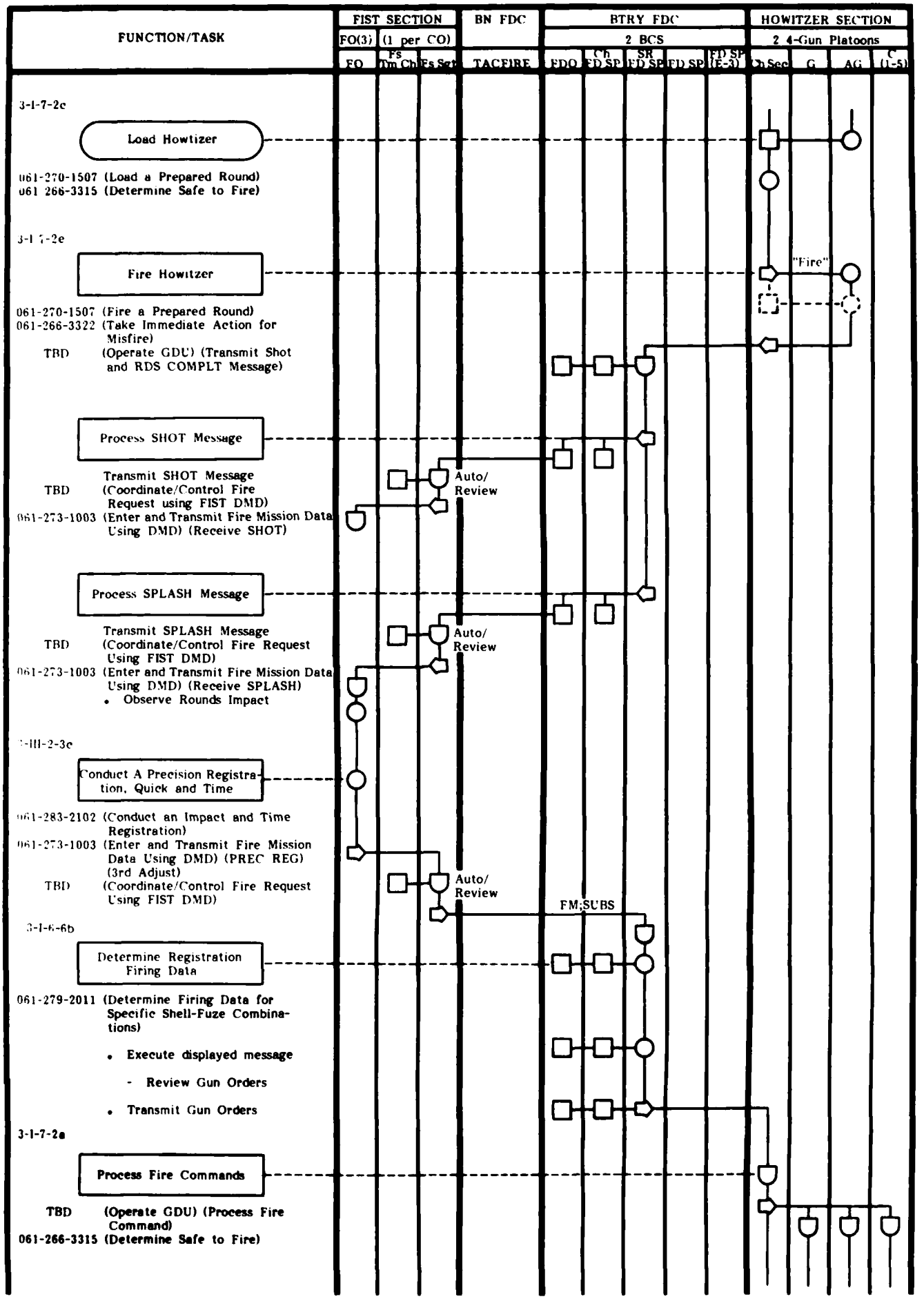


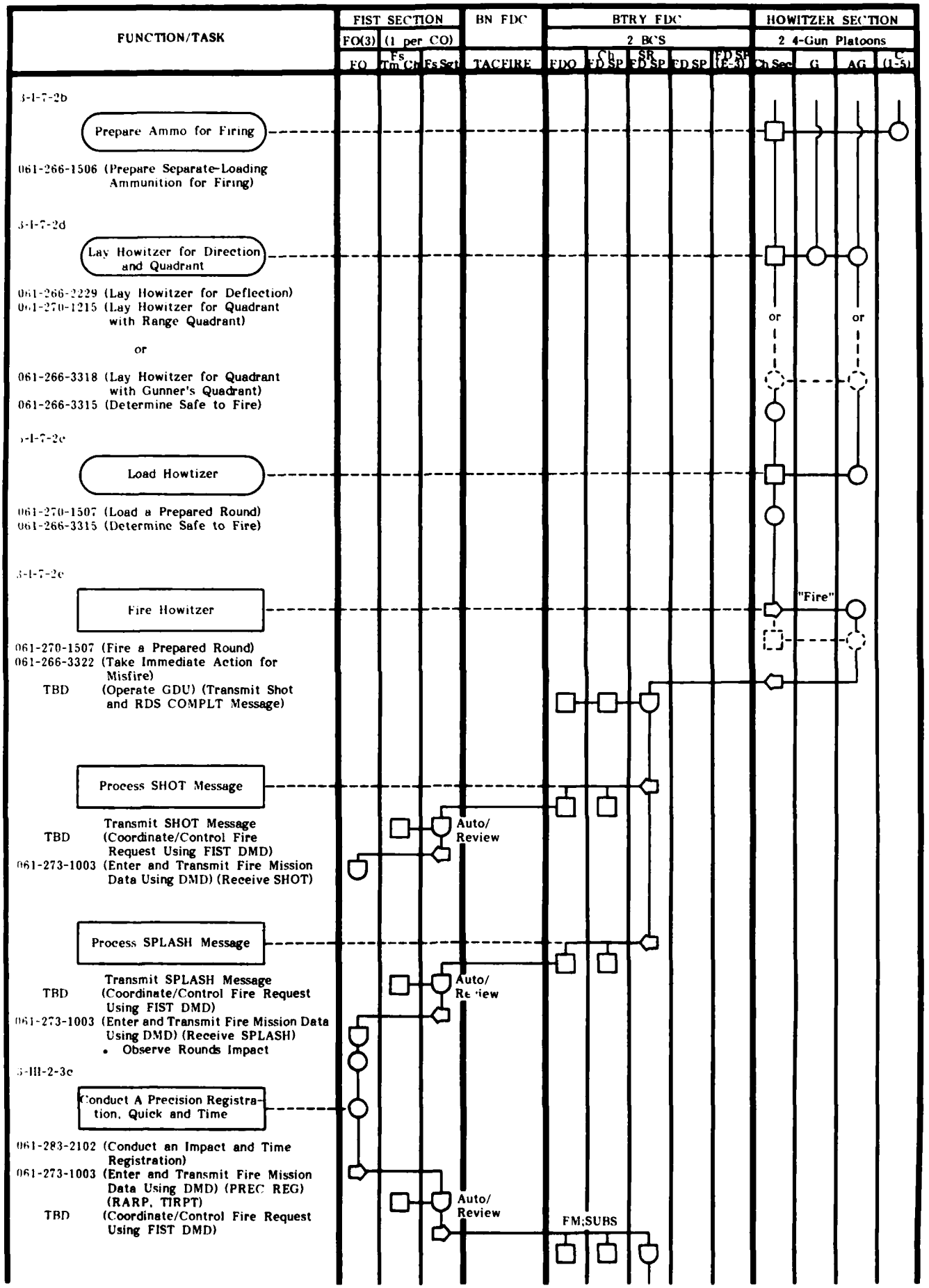
Figure A-6. Precision Registration Mission, Quick and Time.

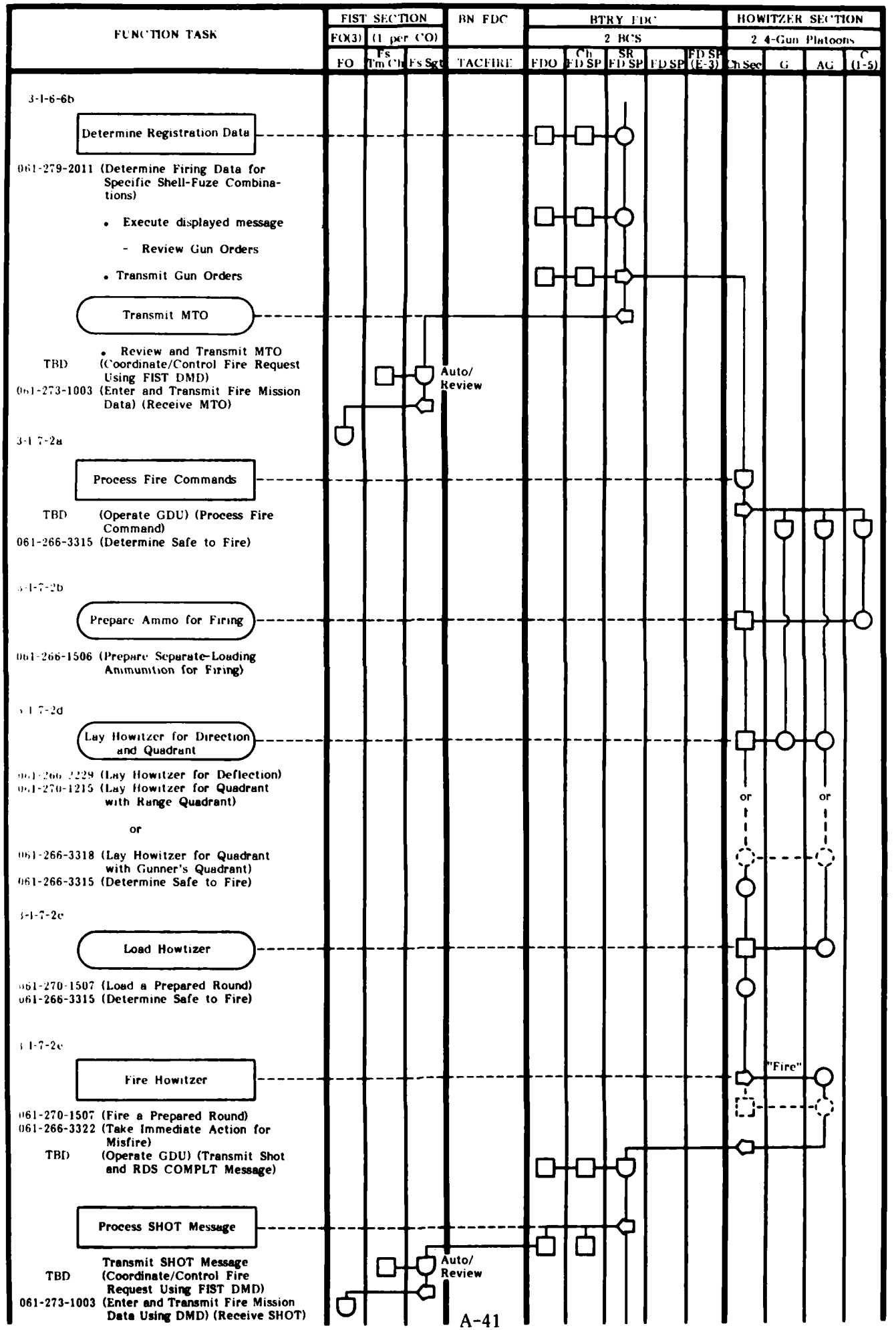

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm
Ch Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (C-5)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-I-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-I-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3e
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (1st Adjust)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM SUBS

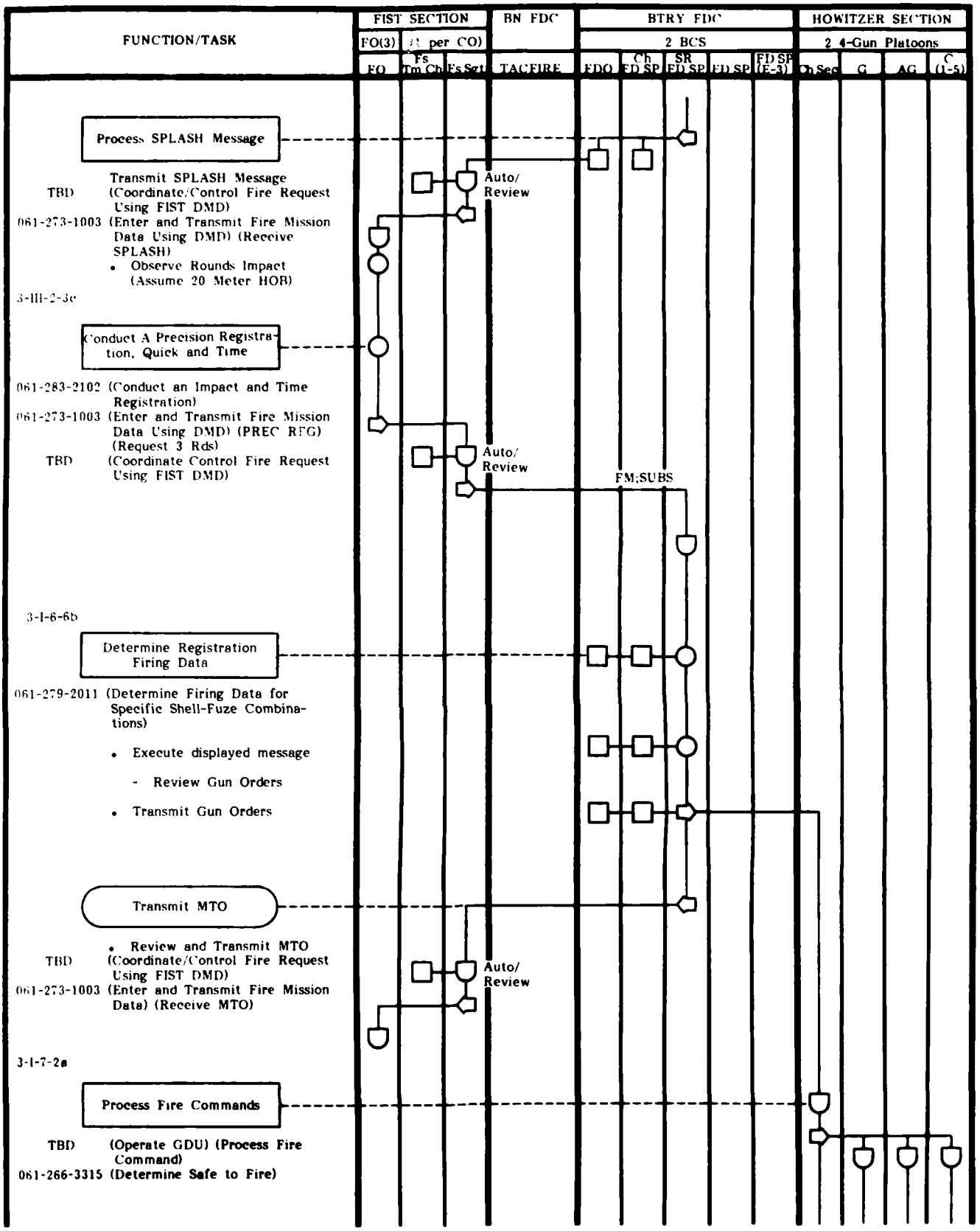

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-6b
Determine Registration Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-3229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2e
Load Howitzer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-1-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review

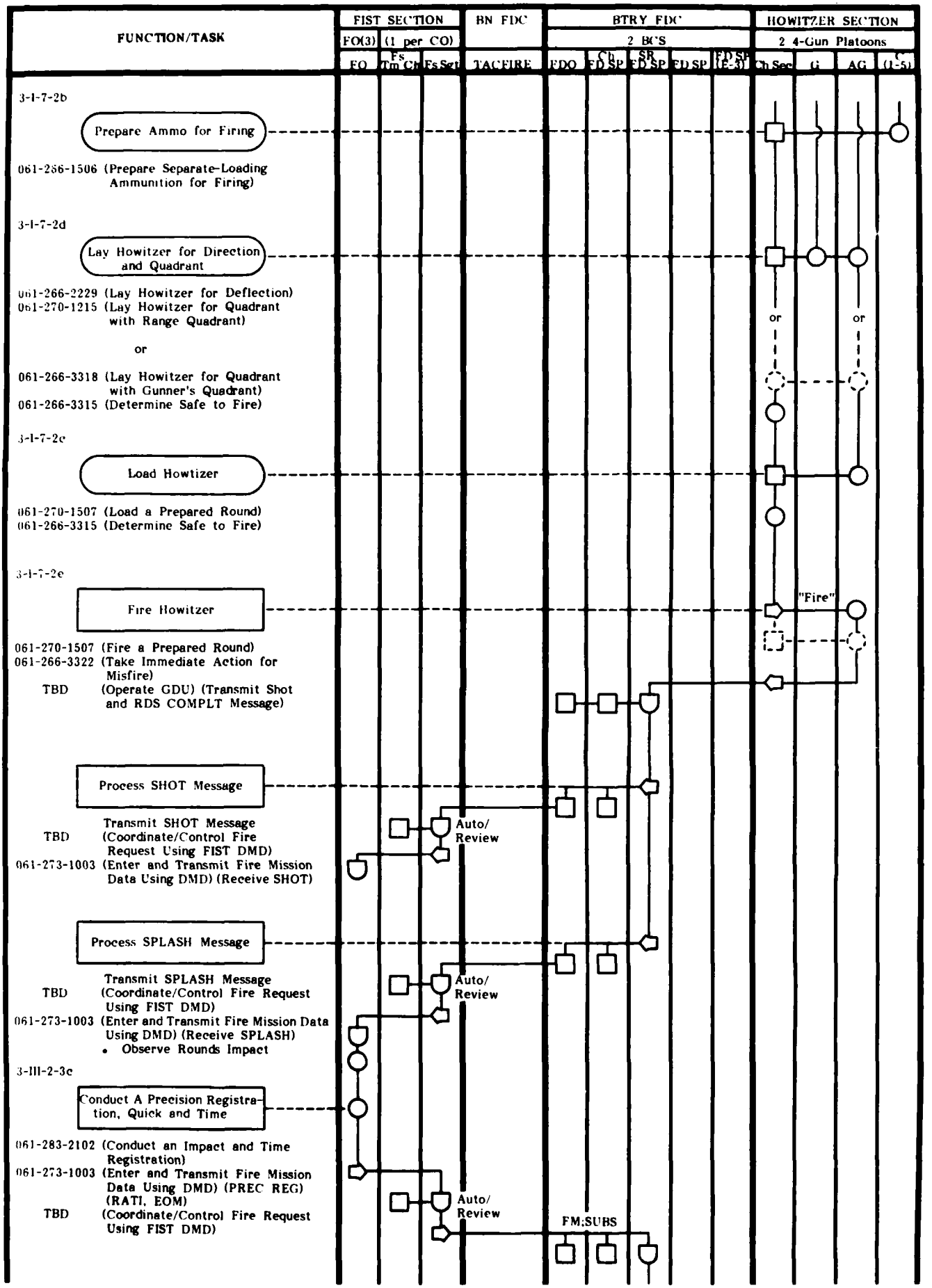

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3e
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct and Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (2nd Adjust)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS
3-I-6-6b
Determine Registration Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or

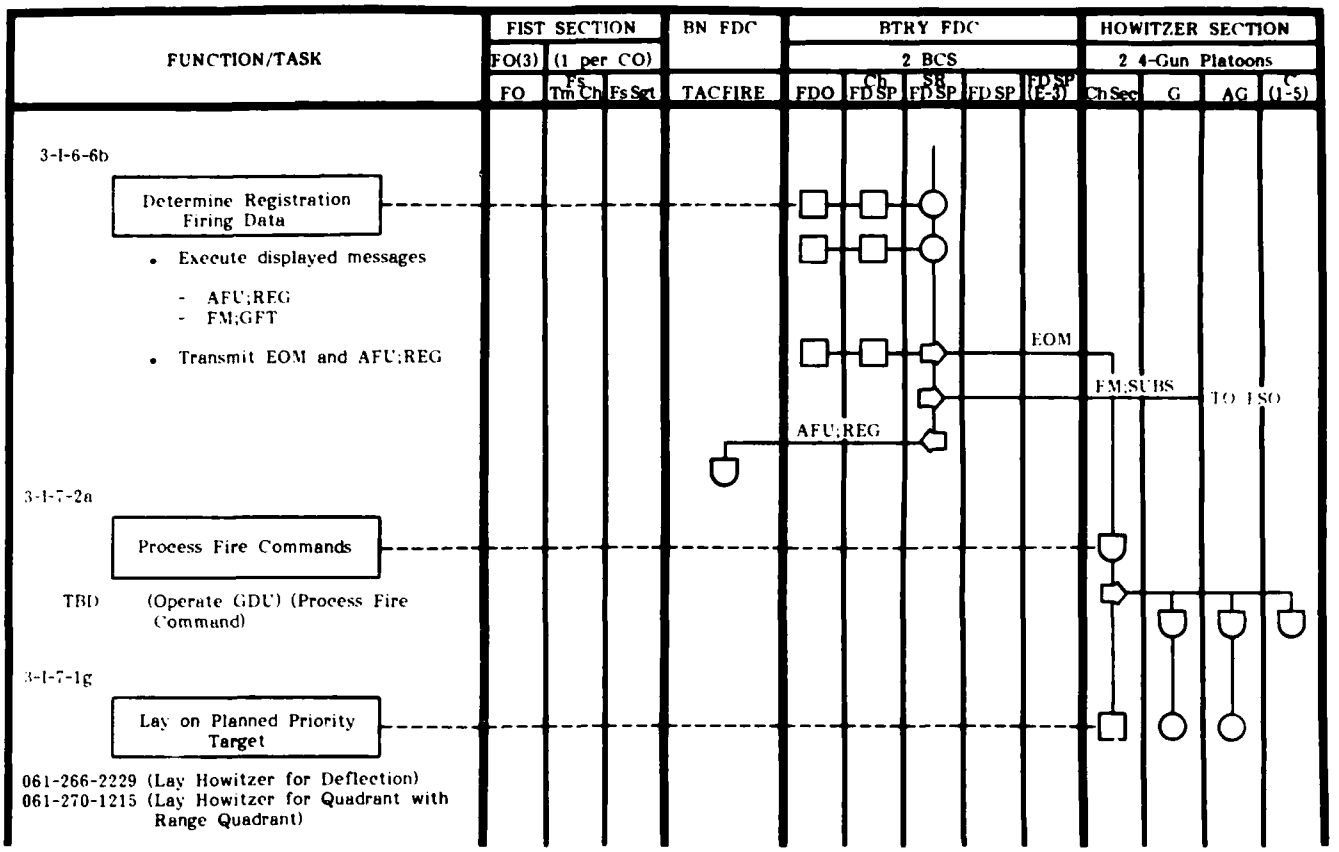

FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (U-5)
3-1-7-2c
Load Howitzer
061-270-1507 (Load a Prepared Round)
061 266-3315 (Determine Safe to Fire)
3-1-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
Transmit SPLASH Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3c
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (3rd Adjust)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS
3-1-6-6b
Determine Registration Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm
Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-4)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-1-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3c
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (RARP, TIRPT)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS


FUNCTION TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-1-6-6b
Determine Registration Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
Transmit MTO
• Review and Transmit MTO
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive MTO)
Auto/ Review
3-1-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)
3-1-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-1-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-1-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-1-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
Transmit SHOT Message
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review


FUNCTION/TASK
FIST SECTION
FO(3)
(3 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (O-5)
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact (Assume 20 Meter HOB)
Auto/ Review
3-III-2-3c
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (Request 3 Rds)
TBD (Coordinate Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS
3-I-6-6b
Determine Registration Firing Data
061-279-2011 (Determine Firing Data for Specific Shell-Fuze Combinations)
• Execute displayed message
- Review Gun Orders
• Transmit Gun Orders
Transmit MTO
• Review and Transmit MTO
TBD (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data) (Receive MTO)
Auto/ Review
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
061-266-3315 (Determine Safe to Fire)


FUNCTION/TASK
FIST SECTION
FO(3)
(1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BC'S
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-5)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2b
Prepare Ammo for Firing
061-286-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-I-7-2c
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
3-I-7-2e
Fire Howitzer
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
"Fire"
Process SHOT Message
TBD Transmit SHOT Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SHOT)
Auto/ Review
Process SPLASH Message
TBD Transmit SPLASH Message (Coordinate/Control Fire Request Using FIST DMD)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (Receive SPLASH)
• Observe Rounds Impact
Auto/ Review
3-III-2-3c
Conduct A Precision Registration, Quick and Time
061-283-2102 (Conduct an Impact and Time Registration)
061-273-1003 (Enter and Transmit Fire Mission Data Using DMD) (PREC REG) (RATI, EOM)
TBD (Coordinate/Control Fire Request Using FIST DMD)
Auto/ Review
FM;SUBS


FUNCTION/TASK
FIST SECTION
FO(3)
FO
(1 per CO)
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SB FD SP
FD SP
FD SP (E-5)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-6-6b
Determine Registration Firing Data
• Execute displayed messages
- AFU;REG
- FM;GFT
• Transmit EOM and AFU;REG
EOM
FM;SUBS
TO FSO
AFU;REG
3-I-7-2a
Process Fire Commands
TBD (Operate GDU) (Process Fire Command)
3-I-7-1g
Lay on Planned Priority Target
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)

5. Copperhead, Target of Opportunity Mission, Autonomous

This fire mission is illustrated in Figure A-7 on the following page. The mission is initiated by the FIST, equipped with a GLLD by performing function 3-III-1-6, Locate Targets of Opportunity and Transmit Call for Fire for Copperhead. Upon receipt of the fire request, the battery FDC in the autonomous role coordinates and controls the fire mission by performing functions 3-I-6-7a, Determine Method of Attack; 3-I-6-7b, Issue Battery Fire Order; and 3-I-6-8, Determine Firing Data. The BCS operator transmits the RFAF message to the FSO, the gun orders to the howitzer section and the MTO to the observer. The howitzer section performs the following functions in executing the gun orders: 3-I-7-2a, Process Fire Commands; 3-I-7-2b, Prepare Ammo for Firing; 3-I-7-2d, Lay Howitzer for Direction and Quadrant; 3-I-7-2c, Load Howitzer; and 3-I-7-2e, Fire Howitzer. As the howitzers fire, they transmit SHOT. When the appropriate number of rounds have been fired, ROUNDS COMPLETE is also transmitted to the battery FDC. The battery FDC responds by transmitting the SHOT/DESIGNATE for the first round. The observer performs function 3-III-1-6a, Designate a Target of Opportunity for Copperhead, observes the burst and awaits the second SHOT/DESIGNATE. A second Copperhead round is fired; typically 30 seconds after the first round. The battery FDC transmits the appropriate message to the observer who designates the target. The observer performs function 3-III-2-3c, Observe Munition Effects and Report Battle Damage Assessment, and transmits EOM to the battery FDC. The battery FDC transmits an FM;SUBS message to the FSO and an EOM message to the howitzer section. The section acknowledges and ends the mission by performing function 3-I-7-1g, Lay on Priority Target.

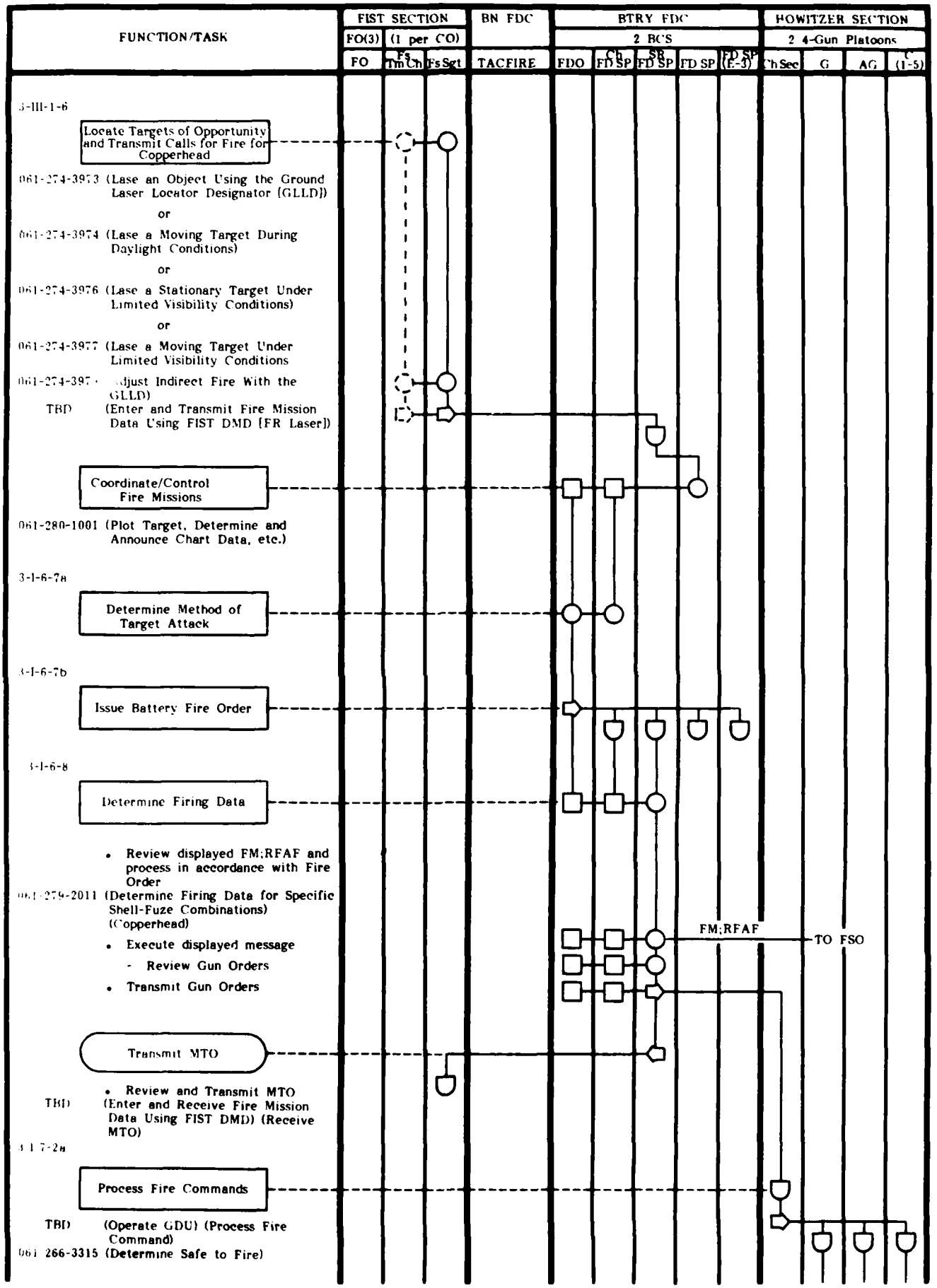
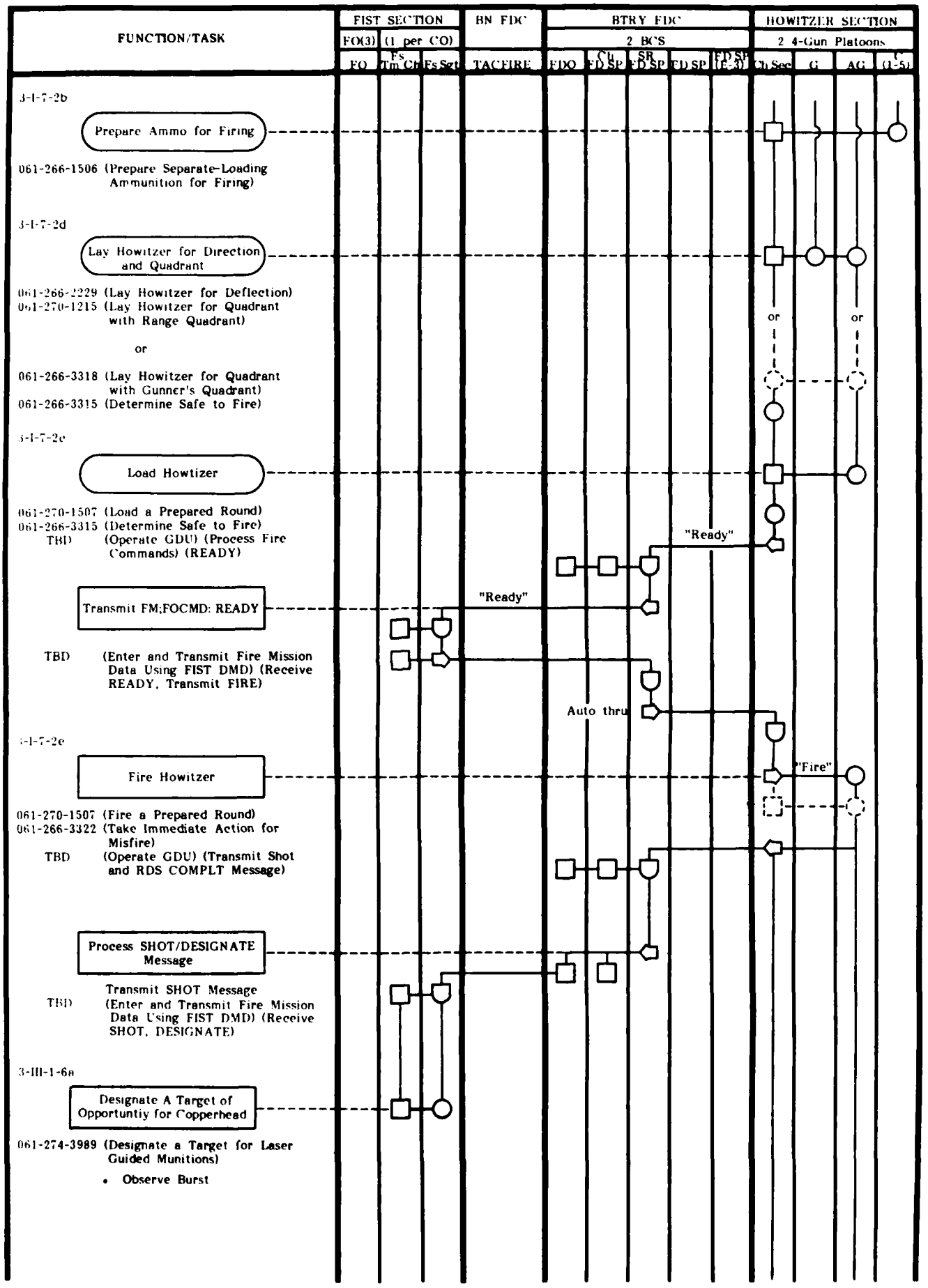
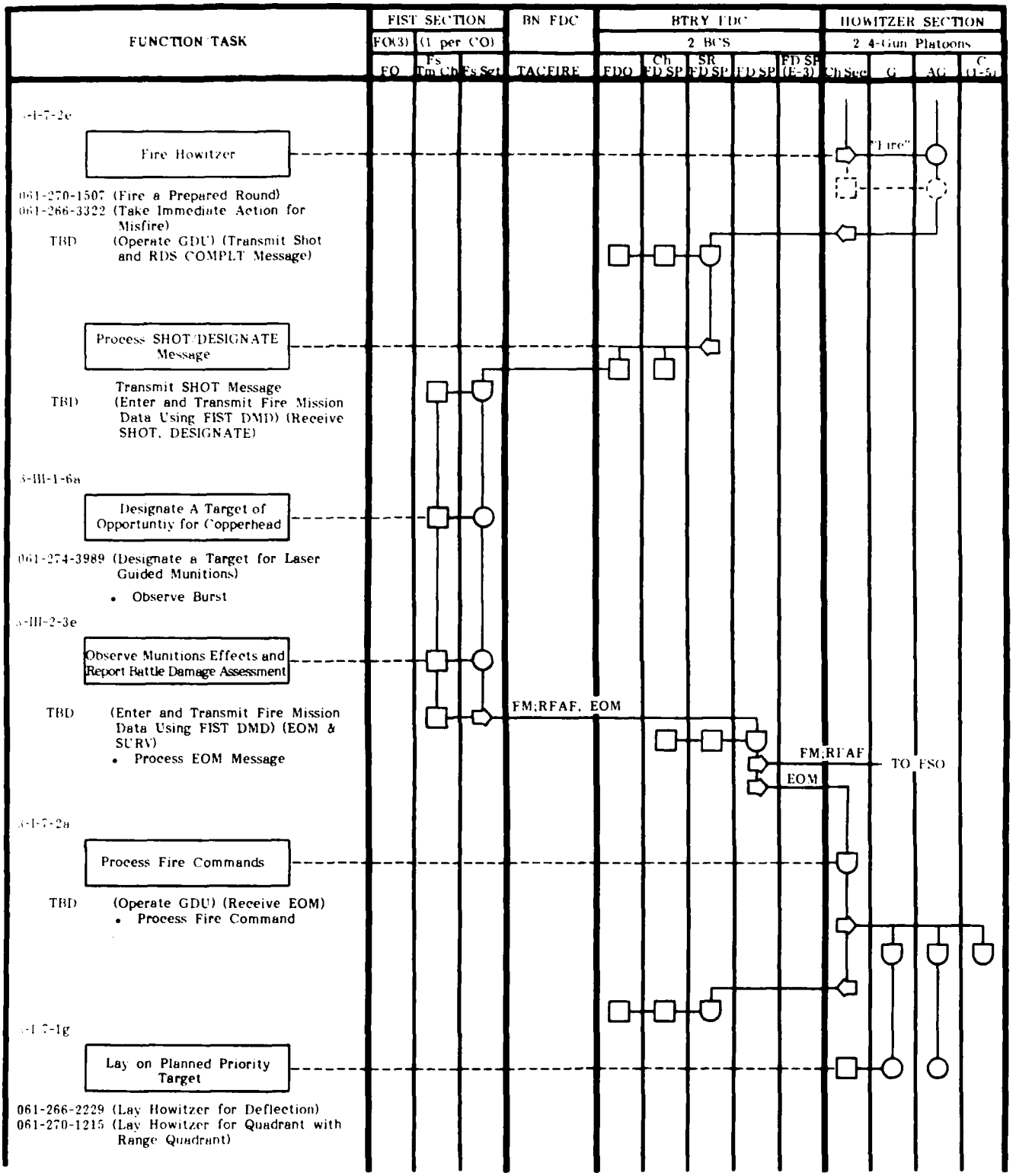


Figure A-7. Copperhead Target of Opportunity Mission, Autonomous.


FUNCTION/TASK
FIST SECTION
FO(3) (1 per CO)
FO
FFs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BC'S
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (Reqd)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (1-5)
3-I-7-2b
Prepare Ammo for Firing
061-266-1506 (Prepare Separate-Loading Ammunition for Firing)
3-I-7-2d
Lay Howitzer for Direction and Quadrant
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)
or
061-266-3318 (Lay Howitzer for Quadrant with Gunner's Quadrant)
061-266-3315 (Determine Safe to Fire)
or
or
3-I-7-2e
Load Howtizer
061-270-1507 (Load a Prepared Round)
061-266-3315 (Determine Safe to Fire)
TBD (Operate GDU) (Process Fire Commands) (READY)
"Ready"
Transmit FM;FOCMD: READY
"Ready"
TBD (Enter and Transmit Fire Mission Data Using FIST DMD) (Receive READY, Transmit FIRE)
Auto thru
3-I-7-2e
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT/DESIGNATE Message
Transmit SHOT Message
TBD (Enter and Transmit Fire Mission Data Using FIST DMD) (Receive SHOT, DESIGNATE)
3-III-1-6a
Designate A Target of Opportuntiy for Copperhead
061-274-3989 (Designate a Target for Laser Guided Munitions)
• Observe Burst


FUNCTION TASK
FIST SECTION
FO(3) (1 per CO)
FO
Fs Tm Ch
Fs Sgt
BN FDC
TACFIRE
BTRY FDC
2 BCS
FDO
Ch FD SP
SR FD SP
FD SP
FD SP (E-3)
HOWITZER SECTION
2 4-Gun Platoons
Ch Sec
G
AG
C (O-5)
Fire Howitzer
"Fire"
061-270-1507 (Fire a Prepared Round)
061-266-3322 (Take Immediate Action for Misfire)
TBD (Operate GDU) (Transmit Shot and RDS COMPLT Message)
Process SHOT/DESIGNATE Message
TBD Transmit SHOT Message (Enter and Transmit Fire Mission Data Using FIST DMD) (Receive SHOT, DESIGNATE)
Designate A Target of Opportuntiy for Copperhead
061-274-3989 (Designate a Target for Laser Guided Munitions)
• Observe Burst
Observe Munitions Effects and Report Battle Damage Assessment
TBD (Enter and Transmit Fire Mission Data Using FIST DMD) (EOM & SURV)
• Process EOM Message
FM;RFAF, EOM
FM;RFAF
EOM
TO FSO
Process Fire Commands
TBD (Operate GDU) (Receive EOM)
• Process Fire Command
Lay on Planned Priority Target
061-266-2229 (Lay Howitzer for Deflection)
061-270-1215 (Lay Howitzer for Quadrant with Range Quadrant)

APPENDIX B

SUMMARY OF INPUT-PROCESS-OUTPUT ANALYSIS RESULTS

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*Included in Task 061-283-1011
**Included in Task 061-283-2001
***Included in Task 061-283-2021

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APPENDIX B

SUMMARY OF INPUT-PROCESS-OUTPUT ANALYSIS RESULTS

Introduction

This appendix is included with the GTT description as part of the information about using the trainer. In the body of the report, it is indicated that an instructor should have available descriptions of the fire missions that are to be trained as well as detailed information about each task in the missions. The instructor will plan and oversee the training process using this information. Also, it will aid in training need diagnosis and readiness assessment. Appendix A contains flow diagrams and narrative descriptions of the five selected missions. This appendix contains detailed task information including performance measures, and criteria. These details were produced in an Input-Process-Output (IPO) analysis. That analysis was applied to the baseline system to provide a data base for the definition of training requirements and for the evaluation of training devices. The completed IPO data sheets contain a detailed description of the elements that make up each Soldier's Manual task. The nature of the performance in each element as well as definitions of how each may be observed/measured are also presented. Relevant conditions under which the task is performed are listed and all identified standards of performance are shown. For almost every task, a Training Requirements Index (TRI) is shown. The TRI values range from 25-89; the higher values denote tasks for which a greater expenditure of training resources is justified than for task with low values. The index is a combined indication of difficulty and criticality based on assessment by artillery subject matter experts (SMEs).* While this index has never proven to be as potent as had been originally intended, it is a convenient basis for distinguishing between tasks when a conflict over training resources is encountered. The TRI is discussed further in the body of this report.

The purpose of the IPO was to identify the specific processes (operator activities) that make up each Soldier's Manual task and to define performance standards and measures associated with each process and task. The IPO was applied to the baseline system and the results are descriptive of that system's performance. The data used in the analysis came from the inventory and evaluation of the Soldier's Manual tasks and the Operational Sequence Diagram completed earlier. In addition, details of performance, especially standards and measures were extracted from appropriate Soldier's Manuals, Field Manuals and the ARTEP Manual for the baseline. From all of these sources, the IPO developed a detailed statement of operator performance which includes what the operator is required to do, how the performance is or could be measured and what means for performance measurement (or assessment) are currently used.

Figure B-1 is a sample page from an IPO for a Cannoneer's task and will serve to illustrate the method. Beginning at the upper left corner, the heading identifies the subsystem (FO/FIST, FDC or Howitzer) in which the task is performed and identifies the crew member (or members) to whom the task is

*There are no TRIs shown for those tasks identified late in the program when the SME review had been completed.

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Position(s): Cannoneers (C2,3,4,HD)
Prerequisites: Sep Load Ammo Available; Fuze Wrencher, Setters Provided; Night Lite Device Provided; Sec Hand Tools Available
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)
Page 1 of 4 Pages
Revision 1 Date: 11/28/83
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Prepare Ammo for Firing (C2,3,4,HD) SM Task # & Name (1/1) 061-266-1506 Prepare Separate-Loading Ammunition for Firing (C2,3,4,HD) TRI: 61 References/Notes: • TM9-2350-303-10 (Chapters 2 & 4) • SM (FM6-13B) 1) All ammunition preparation accomplished outside howitzer 2) Shell, fuze and charge preparation actions are not necessarily performed sequentially	1a) Visibility due to darkness 5) Weather (snow, rain, sleet) 6) Terrain (desert, jungle, etc.) 8) Work space restriction 9) Personal equipment and/or clothing including gloves and mask	Ch Sec	Fire commands—announced shell (1,2)	None	Hear announced fire command	Initiation of task	C3	00:00	Preparation of ammunition task is initiated promptly	Observe performance
				None	C3 Repeat shell/rounds	Repeated shell/rounds	C3,(Self) Ch Sec		Shell correctly repeated (SM/TM)	Compare repeated shell to announced shell
				Shell	Select shell according to color codes and markings stenciled on shell and containers	Shell selected according to announced shell	C3 (Self)		Color codes and markings on shell selected correctly (SM)	Compare selected shell to announced shell
				Shell	Remove any sand, dirt, oil or grease on shell and inspect for damage and corrosion	Cleaned/undamaged shell	C3 (Self)		Shell is free of any foreign matter and is not damaged or corroded (TM)	Visually inspect shell for cleanliness
				Shell Grommet Rotating band	Remove grommet and examine rotating band to ensure it is free of dirt and burrs (3)	Cleaned rotating band	C3 (Self)		Rotating band properly inspected and cleaned (TM)	Visually inspect to ensure rotating band is free of dirt and burrs
				Shell	Visually verify entire shell is free of foreign matter/defects and hold shell upright for fuzing	Shell inspected and held upright for fuzing	C3 (Self)		Shell properly inspected and ready for fuzing (TM)	Observe shell ready for fuzing
		Ch Sec	Fire commands—announced charge (1,2)	None	C4 Repeat announced charge	Repeated charge	C4, (Self), HD, Ch Sec		Charge correctly repeated (SM/TM)	Compare repeated charge to announced charge
				Propellant Charge	Select charge according to announced fire command	Charge selected according to announced charge	C4,HD (Self)		Charge selected correctly compares to charge announced (TM)	Compare selected charge to announced charge

Figure B-1. Sample IPO Analysis Sheet

normally assigned. At the center are listed the prerequisites to initiating the task. These describe the equipment/tools required as well as the status of the system. Next, each task is classified as either a procedural task or a variable task. A procedural task is one which is defined by an inflexible procedure such as loading a howitzer. Procedural tasks usually are related to equipment operation. A variable task is one in which performance is controlled by the crew member. The sequence of performing the tasks elements and the determination that the task has been completed are the responsibility of the crew member. Making a decision is a good example of a variable task. For example, requesting and adjusting fire requires the Forward Observer to evaluate or make decisions about what is seen following no specified procedure. This is a variable task.

The first column on the left contains the name and Soldier's Manual number of the task. At the top of the column (boldface type) is the name of the function of which the task is a subset. These functions are the same as used in the ARTEP (10) and in the current OSD. The function and task names are consistent among the IPO analysis, the ARTEP and the OSD to facilitate indexing among these three documents. Immediately below the task name is shown the Training Requirements Index (TRI) developed in the first part of this study. The TRI is a compilation of four measures of task characteristics that were assigned by subject matter experts during the task evaluation.

Referring again to Figure B-1, the first column on the left is completed with the identification of the documents on which the IPO analyses were based. Most usually this includes the relevant Soldier's Manual and Technical Manual. At the bottom of the first column, there are notes, as required, to clarify the analysis.

The second column of this form is a compilation of factors that affect task performance. These factors were identified by subject matters experts at the Field Artillery School during task evaluation in the first part of this study. These have been compiled in this part of the study to facilitate reference in the definition of training requirements.

The actual Input-Process-Output (IPO) analysis is documented in the remainder of this form. For this analysis, each task has been divided into the several component activities that make up the total task. This division is done empirically, the objective being to define activities that are meaningful work units, that are sensible (i.e., it can be observed by an instructor or can be associated with an equipment function) and, finally, that can be related to a performance criterion of speed and/or accuracy. For example, in tasks involving the use of digital message devices, one activity is simply pushing the Acknowledge key because this can be used to establish response times. Also, in those tasks, "Review Message" is a single activity because it is a functional entity and because time and accuracy measures would be useful criteria and could be implemented. These activities are also relevant to training needs definition because they are functional entities and can be "observed" and measured. When the activities have all been completed, the "process" of the task is finished and a result, or output, is produced. That output denotes the completion of the task and service as input to any succeeding, sequential tasks.

The "Input" column describes the source and content of the stimulus for the process that follows it. Input can be the information needed for the

process, it can be a state of the system or an equipment that is necessary for initiating the process or it can be an operational condition. For example, the receipt of a Fire Message is the stimulus for initiating gun-laying processes and the content of the message provides the data for performing the processes. As another example, the presence of a target is an input to Forward Observer tasks. The input is also identified as to source--which can be a piece of equipment or a person. Input can be generated by the operator performing the task in which case the source is named "self."

The "Process" section of the IPO form describes what the person to whom the task is assigned does with the input or does as a consequence of receiving the input. The equipment, if any, used in the process is also identified.

The "Output" column describes the content and destination of the product of the process. The output may serve to initiate a task performed by the same person or one performed by someone else. It can be input to more than one other task. The output may or may not be tangible. For example, one Cannoneer activity is to hear and repeat a part of the Fire Message as given by the Chief of Section. The Cannoneer's repetition of the Announced Charge, for instance, is the output of the activity "Repeat Announced Charge" and is the stimulus (input) to his actually selecting the powder charges.

The last three columns to the right of the form are concerned with the assessment of performance. The column headed "Time" was included for recording any specified elapsed or cumulative times. For a few tasks, or processes, the ARTEP or the Soldier's Manual stipulates a desired or a tolerable time of performance. Those times are recorded here. The "Performance Standard" is a description of an observable condition or event from which the completion and/or the quality of performance can be judged. Some of these standards appear in the Soldier's Manual and others have been defined in this study. The "Present Assessment Method" simply describes how the standard is or could be observed during system operation.

The IPO data sheets for each of the 58 SM tasks included in the gunnery team engagement process are presented next. The sheets are grouped by FIST/FO, FDC and Howitzer; they are in numerical order in each group.

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO
Prequisites: Digital Comm. Established; Task 061-283-2101 Completed
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 12/8/83
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
SM Task # & Name 061-273-1003 Enter and Transmit Fire Mission Data Using the DMD (FO) TRI: 74 References/Notes • TM11-7440-281-12 & P (DMD) (Chapter 2, Pg. 2-97) • TM11-7440-283-12-1-1 (BCS) (Chapter 3, Pg. 3-37) • SM (FM6-13F) • This DMD Task Supports Several Functions	1) Visibility --darkness 4) Temperature/humidity 5) Extreme weather (snow, rain, sleet) 6) Type of terrain (flat, hilly, rolling, mountainous) 7) High communications load 9) Personal equipment and clothing (gloves, mask) 10) Operational state (enemy action, target load, commander's guidance	Self (FO)	Coordinates and direction of selected RP (task 061-283-2101)	DMD	Select Mode and A Keys on DMD	Menu of message types	Self (FO)	00:00	Communication task initiated promptly	Measure interval between RP determination (coordinates and direction) and initiation of DMD communication
				DMD	Select Freetext Message and enter FO authenticator code and messages destination	Display advances to permit entry of text	Self (FO)		Freetext Message format selected without error (SM)	Observe Freetext Message format and correct destination
		Self (FO)	Recorded RP coordinates and/or direction	DMD	Enters RP coordinates and/or direction	Displayed Freetext Message of RP coordinates and/or direction	Self (FO)		Coordinates and/or direction correctly entered on DMD (SM)	Compare displayed and recorded coordinates and/or direction
				DMD	Press XMIT key to transmit message	Display cursor flashing and XMIT in message heading. Indications of message received.	Self (FO), FIST	00:90	Message transmitted within 90 seconds without procedural error (SM)	Measure time for total task (completion of task 061-283-2101 to activate XMIT). Observe operator procedure

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Fire Support Team
Section Position(s): FIST Ch/FS Sgt
Prequisites: FIST Established; GLLD Oriented; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 2/7/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3973 (FIST Ch/FS Sgt) Lase an Object Using the Ground Laser Locator Designator (GLLD) AN/TVQ-2 TRI: 61 References/Notes • TC 6-30-1	1a) Visibility environmental 1b) Visibility equipment 2a) Noise equipment 2b) Noise environmental 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FIST Ch/FS Sgt)	Terrain feature/object/target	Binoculars or any target acquisition equipment available to FIST	Scan zone of observation while sighting through binoculars and locate a terrain feature, object or target to be lased	Observation of suitable feature, object or target for which lasing data are to be obtained. Initiation of lasing task. . .	Self (FIST Ch/FS Sgt) . . .	00:00	Select a feature, object or target which is visible (line of sight) and can be lased without delay	Observe suitability of object for lasing. No delay from need to lase to actual location of desired lasing point
				GLLD	Set the power to ON and RNG/DES to RNG 1 or 2	Power ON RNG/DES switch to RNG 1 or 2	Self (FIST Ch/FS Sgt)		Power and RNG/DES switches in correct positions without error (SM)	Observe switch position indications
				GLLD	Loosen azimuth and elevation gimbal locks	GLLD free to rotate in azimuth and elevation	Self (FIST Ch/FS SGT)		Azimuth and elevation gimbal locks are loosened properly (SM)	Attempt to rotate the GLLD in azimuth and elevation
			Terrain feature/object/target	GLLD	Rotate the laser/designator while sighting through eyepiece and align crosshairs on desired target	Crosshairs on desired target	Self (FIST Ch/FS Sgt)		Crosshairs centered on target (TC, SM)	Observe that crosshairs are on the desired target
				GLLD	Announce "LASING." Pull and hold the trigger switch and read the values for azimuth, range, and elevation; then release trigger switch	"LASING" announced. Azimuth range and elevation values are obtained	Self (FIST Ch/FS Sgt)		LASING announced just before trigger switch activated. Azimuth, range and elevation values are correctly announced (SM)	Hear LASING announced. Read actual azimuth, range and elevation values and compare to operator's. Measure elapsed time of GLLD operation

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Fire Support Team
Section Position(s): FIST Ch/FS Sgt
Prequisites: FIST Established; GLLD Oriented; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 2/8/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3974 (FIST Ch/FS Sgt) Lase a Moving Target during Daylight Conditions TRI: 74 References/Notes • TC 6-30-1	1a) Visibility environmental 1b) Visibility equipment 2a) Noise equipment 2b) Noise environmental 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FIST Ch/FS Sgt)	Moving target in zone of observation	Binoculars	Scan zone of observation and detect/locate a moving target to be lased	Observation of a moving target. Initiation of lasing task. . . .	Self (FIST Ch/FS Sgt) . . .	00:00	Target is visible (line of sight) and can be lased without delay	No delay in initiating the task once target entered zone of observation
				GLLD	Set the power to ON and RNG/DES to RNG 1 or 2	Power ON RNG/DES switch to RNG 1 or 2	Self (FIST Ch/FS Sgt)		Power and RNG/DES switches in correct positions without error (SM)	Observe switch position indications
				GLLD	Loosen azimuth and elevation gimbal locks	GLLD free to rotate in azimuth and elevation	Self (FIST Ch/FS Sgt)		Azimuth and elevation gimbal locks are loosened properly (SM)	Attempt to rotate the GLLD in azimuth and elevation
				GLLD	Rotate the laser/designator while sighting through eyepiece and align crosshairs on desired target	Crosshairs on desired target	Self (FIST Ch/FS Sgt)		Crosshairs centered on target (TC, SM)	Observe that crosshairs are on the desired target
				GLLD	Announce "LASING" track, pull and hold the trigger switch and read the values for azimuth, range, and elevation; then release trigger switch	"LASING" announced. Azimuth range and elevation values are obtained and announced	Self (FIST Ch/FS Sgt)		LASING announced just before trigger switch activated. Azimuth, range and elevation values are correctly announced (SM)	Observe/monitor ability to track target. Compare GLLD values to announced values. Measure elapsed time for GLLD operation

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented w/Night Sight Installed; Digital Comm. Established

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 2/11/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3976 (FIST Ch/FS Sgt) Lase a Stationary Target under Limited Visibility Conditions TRI: 74 References/Notes • TC 6-30-1 *If target is to be engaged w/copperhead, target should be ranged, using RNG 2, several times to ensure consistent and accurate ranging data.	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 2b) Noise equipment 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FIST Ch/FS Sgt)	Stationary target in zone of observation	GLLD W/AN/TAS-4	With the night sight set to wide field of view (WFOV), scan zone of observation and locate a stationary target	Observation of a stationary target for which lasing data are to be obtained. Initiation of lasing task.	Self (FIST Ch/FS Sgt)	00:00	Initiate lasing of target task without delay	Observe performance
				GLLD W/AN/TAS-4	With the RNG/DES on RNG 1 or 2*, place the TAS-4 reticle on the center of the target and set the FOV to to NFOV. Turn the RANGE FOCUS to focus image. Adjust BRT and CTRS for best image detail	TAS-4 reticle aligned on center of target. Target in focus and appears to be at best image of detail	Self (FIST Ch/FS Sgt)		RNG/DES in correct position. Target is properly aligned in center of reticle. Target in focus and is adjusted for best image detail. (TC)	Observe RNG/DES position set for RNG 1 or RNG 2. Observe target in focus and set for best image detail
				GLLD W/TAS-4	Classify target as wheeled or track vehicle, etc., and identify as friend or foe while viewing target	Target type classified. Identified as friend or foe	Self (FIST Ch/FS Sgt)		Target correctly classified and identified. (TC)	Compare determined classification and identification with actual known target characteristics
				GLLD W/TAS-4	Announce "LASING." Pull and hold the trigger switch and on the GLLD reticle read the values for azimuth, range and elevation; then release the trigger switch	"LASING" announced. Azimuth, range and elevation values are obtained	Self (FIST Ch/FS Sgt)		"LASING" announced just before trigger switch activated. Azimuth, range and elevation values are correctly announced. (SM)	Hear "LASING" announced. Read actual azimuth, range, and elevation values, and compare to operators

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented w/Night Sight Installed; Digital Comm. Established

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 2/20/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3977 (FIST Ch/FS Sgt) Lase a Moving Target under Limited Visibility Conditions TRI: 89 References/Notes • TC6-30-1	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 2b) Noise equipment 3) Moving vehicle 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FIST Ch/FS Sgt)	Moving target in zone of observation	GLLD w/TAS-4	With the night sight set to wide field of view (WFOV) scan zone of observation and locate a moving target	Observation of a moving target for which lasing data is to be obtained. Initiation of lasing task. . .	. . .	00:00	Initiate task of lasing a moving target under limited visibility conditions without delay	None, until lasing task initiated
				GLLD w/TAS-4	With the RNG/DES on RNG 1 or 2 set the FOV to NFOV. Place the TAS-4 reticle on the center of the target while tracking the target. Turn the RANGE FOCUS to focus the image. Adjust BRT and CTRS for best image detail	While tracking the target, the TAS-4 reticle is aligned on the center of mass. Target in focus and appears to be at best image of detail.	Self (FIST Ch/FS Sgt)		RNG/DES in correct position. Target is tracked correctly and aligned in the center of the TAS-4 reticle. Target is in focus and adjusted for best image detail (TC)	Observe RNG/DES position set for RNG 1 or 2. Tracking skill can be monitored using the Sony TV camera on the GLLD. Observe that target is in focus and set for best image detail
				GLLD w/TAS-4	Classify target as wheeled or track vehicle, etc., and identify as friend or foe while viewing the target	Target type classified. Identified as friend or foe	Self (FIST Ch/FS Sgt)		Target correctly classified and identified (TC)	Compare determined classification and identification with actual known target characteristics

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented w/Night Sight Installed; Digital Comm. Established

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 2/20/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				GLLD w/TAS-4	Announce "LASING." Maintain smooth tracking. Pull and hold the trigger switch and on the GLLD reticle read the values for azimuth, range and elevation; then release the trigger switch	"LASING" announced. Azimuth range and elevation values are obtained while tracking the target	Self (FIST Ch/FS Sgt)		"LASING" announced just before trigger switch activated. Azimuth, range and elevation values are correctly announced	Hear "LASING" announced. Tracking skills can be evaluated via the V/GLLD trainer set

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: FIST Established; GLLD Oriented; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs From	Inputs Content	Process Equipment	Process Actions	Outputs Content	Outputs To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3979 Adjust Indirect Fire with Ground Laser Locator Designator (GLLD) AN/TVQ-2 TRI: 74 References/Notes • (SM) FM6-13F Pg. 20290 • TC6-30-1 Section 2	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state		Target in zone of observation (detected, classified, identified)	Binoculars, GLLD	Decide to request fire with GLLD	Initiate task	Self		Target detected and and correctly classified/ identified	Observe performance
				GLLD, FIST DMD	Perform SM task 061-274-3973. Lase an object	Target location entered automatically into FIST DMD message format	Self		Direction, range and vertical angle values use correct. Distance to nearest 10 meters, direction and vertical angle to nearest mil	Lase target and compare values
				FIST DMD	Complete appropriate message format and transmit FM message	Message format completed and transmitted	FDC Self		Message completed without procedural error and and promptly transmitted	Observe message prepared without error and promptly transmitted
		FDC	MTO, Shot and Splash messages	FIST DMD	Read message contents	Knowledge of message contents	Self		Messages processed promptly	Observe performance
		Self	Shell burst	GLLD	Loosen azimuth and elevation symbol locks. Observe the burst. Rotate the GLLD while sighting through eyepiece and align cross hairs on burst/smoke	Cross hairs on	Self		GLLD cross hairs centered on burst with no delay	Observe performance
				GLLD, FIST DMD	Pull hold the trigger switch and read the direction, range, and vertical angle values	Direction, range and vertical angle values entered on FIST DMD	Self		Direction, range and vertical angle values are automatically filled in on FIST DMD	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: FIST Established; GLLD Oriented; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
			GLLD data on FIST DMD	FIST DMD	Complete subse-quent adjust message format and transmit data	Message format completed and transmitted	FDC		Message completed without procedural error and promptly transmitted	Observe message prepared without procedural error
			Subsequent adjustment made until rounds ± 50 meters of target.							
			Lase bursts within FFE range and deviation	FIST DMD	Complete FFE message and transmit data	FFE data entered and transmitted	FDC		(Same as above)	(Same as above)
			Shot and splash messages	FIST DMD	Read message contents	Knowledge of message contents	Self		Messages processed promptly	Observe performance
			FFE bursts	GLLD/ Binoc-ulars	Observe FFE result effective	Transmit EOM and results	FDC		FFE entered by third round EOM and results transmitted without delay	Observe and evaluate FFE and EOM results

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented & Focused; Digital Comm. Established; Copperhead FM In-Process

Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/20/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Designate Target of Opportunity for Copperhead SM Task # & Name 061-274-3989 (FIST Ch.FS Sgt) Designate a Target for Laser Guided Munitions TRI: 61 References/Notes • FM6-13F (Pg. 2-295) • TC6-30-1 (Pgs. 52-61) Functional Description FDT&E-FIST DMD June 1982 *If obscured, wait until observed or select another target within planned Copperhead footprint and continue the mission	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 2b) Noise equipment 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FDC	FIST DMD MSG indicator lamp flashing and audible beep	FIST DMD	Observe MSG lamp flashing and hear beep	Initiation of task	Self (FIST Ch/FS Sgt)	00:00	MSG light observed; beep heard	Observe performance
			FIST DMD MTO message w/mission information	FIST DMD	Press MSG key and read message display. EEI to include Copperhead Time of Flight (TOF), Volume of Fire, and Copperhead PRF code	Knowledge of mission related EEI (TOF, Volume of Fire, and PRF code)	Self (FIST Ch/FS Sgt)		MSG key pressed promptly	Observe MSG indicator lamp, audible beep off and displayed MTO
		Self (FIST Ch/FS Sgt)	MTO-message content on FIST DMD	GLLD	Prepare GLLD for designate mode. Set mode to DES. Set desired PRF indicator codes	GLLD mode to DES. PRF codes set	Self (FIST Ch/FS Sgt)		DES mode properly set. PRF code indicator set to desired code (SM)	Observe mode set to DES. Compare desired PRF code w/actual set code
		FDC	FIST DMD MSG indicator lamp flashing and audible beep	FIST DMD	Observe lamp flashing and hear beep	Knowledge that MSG must be acted upon	Self (FIST Ch/FS Sgt)		MSG light observed; beep heard	None until MSG key pressed. Observe MSG indicator on; hear beep
			FIST DMD FOCMD-READY message	FIST DMD	Press MSG key and read message display	Knowledge that howitzers "ready" to fire	Self (FIST Ch/FS		MSG key is pressed promptly	Observe MSG indicator lamp audible beep off READY message displayed
		Self (FIST Ch/FS Sgt)	Target visibility	GLLD	Sight through the eyepiece and if moving, track target and observe target not obscured.* If target stationary, determine not obscured	Target is visible or target is not visible and new target within footprint can be fired upon	Self (FIST Ch/FS Sgt)		Track and sight moving target (not obscured) promptly. Or if obscured, select new target in vicinity of Copperhead footprint promptly	Observe target obscured/not obscured. Observe target to be fired upon is within Copperhead footprint

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented & Focused; Digital Comm. Established; Copperhead FM In-Process

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/20/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				FIST DMD	Prepare and transmit FOCMD-FIRE message	FOCMD-FIRE message transmitted	FDC-How Sec Self (FIST Ch/FS Sgt)		Message prepared w/o error and transmitted promptly after decision target is visible	Observe message prepared w/o error and transmitted promptly
**If no ACK indication, FIST Ch/FS Sgt initiates manual countdown on FIST DMD		FDC	ACK indication on FIST DMD	FIST DMD	Observe TOF counter** counting down	Knowledge that round is on the way	Self (FIST Ch/FS Sgt)		Observe auto-TOF countdown or initiated manual countdown promptly	Observe countdown initiated (auto/manual)
		Self (FIST Ch/FS Sgt)	Target direction and moving/stationary	GLLD	Sight through eyepiece, and position the crosshairs on the target aiming point. If target moving, maintain a tracking rate by applying smooth horizontal and vertical corrections to the handle on the traversing unit. Continue to monitor TOF countdown	GLLD crosshairs on target aim point. Tracking target, if necessary. Countdown continued	Self (FIST Ch/FS Sgt)		Crosshairs on best aim point. Smooth, accurate tracking maintained, if target moving. Countdown maintained accurately	None, other than observing countdown and operator sighting through GLLD
***If designate signal not observed, operator initiates designate. If TOF =/< 20 sec., start designate at FOCMD-FIRE ACK				GLLD	Observe countdown at 20 seconds and GLLD reticle illuminated*** to indicate start designate	Knowledge that countdown at 20 seconds. GLLD reticle is/is not illuminated	Self (FIST Ch/FS Sgt)		Countdown correctly maintained. Detection observed to start designate. Smooth accurate tracking and designate maintained	(Same as above)
				GLLD	Continue to position crosshairs on target aim point and squeeze trigger	Target being designated	Self (FIST Ch/FS Sgt)		Target designated accurately until round impacts	Observe operator squeezing trigger

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST Established; GLLD Oriented & Focused; Digital Comm. Established; Copperhead FM In-Process

Task Classification:
[x] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/20/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
****Typically 2 rounds are fired		Self (FIST Ch/FS Sgt)	Observe round impact/burst	GLLD	Observe burst and continue to designate for any additional shot rounds****	Burst observed. Crosshairs on target. Target continued to be designated	Self (FIST Ch/FS Sgt)		Smooth, accurate tracking maintained while designating. Designate continued until rounds complete (SM)	Observe effects on target
*****FIST Ch/FS Sgt decision to request additional CPHD rounds if effects not achieved		Self (FIST Ch/FS Sgt)	Observe effects on target	GLLD, FIST DMD	Observe effects on target. Cease designate and target tracking. Enter "X" and transmit EOM	Target effect achieved/not achieved. EOM transmitted to FDC if achieved*****	FDC Self (FIST Ch/FS Sgt)		Correctly observed effect on target. EOM transmitted promptly and correctly	Observe and evaluate effect on target. Timeliness of EOM transmitted

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO

Prequisites: Observation Post Occupied; Digital/Voice Comm. Established; FO Equipment Available; Registration Point Known

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 12/9/83

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Perform Observation SM Task # & Name 061-283-1001 Determine Direction within the Target Area (FO) TRI : 74 References/Notes • TM11-7440-281-12 & P (DMD) (Chapter 2, Pg. 2-97) • TM11-7440-283-12-1-1 (BCS) (Chapter 3, Pg. 3-37) • SM (FM6-13F) • FM 6-30, Chapter 3 (Sec. I & II)	1a) Visibility due to: fog, haze, smoke, darkness, terrain masking 1b) Visibility equipment optics—Binoculars, Aiming Circle, BC Scope, Laser Range Finder 2) Noise (ambient) 5) Weather (snow, rain, sleet) 6) Terrain (flat, rolling, hilly, mountainous), availability, of suitable registration features 10) Operational state --enemy action, number of targets, commander's guidance	FDC	DMD flashing MSG light and audible beep	DMD	Observe DMD MSG light flashing and hear beep	Initiation of task	Self (FO)	00:00	MSG light observed, beep heard (TM)	Observe performance
		FDC	PTM message to conduct quick and time registration on a known point	DMD	Press MSG key	Reading of MSG display to conduct registration on known point. Ack to FDC.	Self (FO) FDC		MSG key is pressed promptly (TM)	Observe MSG light and beep extinguished. Observe interval MSG light-MSG button
		Terrain Sketch/ Target Trig List	Knowledge/ Awareness of known registration point (information)	Terrain Sketch/ Trig List of Known Points	Identify known point on terrain sketch or from list of known data as the desired RP	Identification of the desired RP from other known point targets within zone of observation	Self (FO)		Correct identification/ selection of desired RP (known point) (FM)	Compare identified RP with desired RP data
		Terrain Environment	Selected feature/object as RP	M2 compass	Using M2 compass, determine azimuth (direction) to RP	Indications of azimuth reading to RP	Self (FO)		Azimuth to RP correct to the nearest 10 mils (SM)	Measure azimuth to RP and verify azimuth reading
				Pencil, Paper/ Terrain Sketch	Record direction to RP	Determination and recording of direction to RP. Initiation of Task 061-273-1003	Self (FO)	1:00	Direction to known point RP correct within ± 10 mils (SM)	Measure time for total task and verify direction

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; LRF/GLLD Operational
Task Classification: [x] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/21/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Locate Targets and Conduct Indirect Fire Missions SM Task # & Name 061-283-1002 (FO/FIST Ch/FS Sgt) Locate a Target by Grid Coordinates TRI: 74 References/Notes • SM (FM6-13F) (Pg. 2-11) • FM6-30 (Pgs. 3-1, 4-2) • TC6-30-1	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FO/ FIST Ch/FS Sgt)	Target in zone of observation detected, classified and identified	Binoculars	Decision to locate target by grid coordinates	Initiation of task	Self (FO/ FIST Ch/FS Sgt)	00:00	Target detected, correctly classified and identified	Observe performance
				M2 Compass, Paper, Pencil	Perform and record SM 061-283-1001 (Determine Direction within Target Area) to the desired target	Direction to target recorded to the nearest 10 mils	Self (FO/ FIST Ch/FS Sgt)		Direction to target within 100 mils of actual direction expressed to the nearest 10 mils	Measure direction to target and compare values
				GLLD/ LRF	If LRF available, perform task and record SM 061-283-1952 (Operate the LRF) to determine distance to target	Distance in meters to target	Self (FO/ FIST Ch/FS Sgt)		Distance to target accurate to within ± 10 meters (FM)	Measure distance w/ LRF and compare values
					If GLLD available, perform task and record SM 061-274-3973 (Lase an Object w/GLLD)	Range in meters to target	Self (FO/ FIST Ch/FS Sgt)		Distance (range) to target accurate to within ± xx meters	Measure distance w/ GLLD and compare values
				OF Fan, Map	If only map, using OF, orient OF on map. Plot azimuth and via OF and map-terrain analysis, map spot feature where target is located	Visual interpolating of target location in appropriate grid square	Self (FO/ FIST Ch/FS Sgt)		Target located visually in appropriate grid square	Observe and compare target location on map

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; LRF/GLLD Operational
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/21/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		Self (FO/ FIST Ch/FS Sgt)	Distance in meters determined by LRF/GLLD	Map, Plotting Equipment	Plot the distance and direction from own location to the target on the map	Target location identified on map	Self (FO/ FIST Ch/FS Sgt)		Target location associated with correct feature on the map	Observe and compare determined map location
			Target location on map	Coordinate Scale, Map	By eye or by using coordinate scale, determine six-digit grid location to target on map	Determination of a six-digit coordinate of actual target location	Self (FO/ FIST Ch/FS Sgt)	00:30	Determine six-digit coordinate of the target location within 30 seconds	Measure time from start to task completion. Determine grid coordinates and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; OP Location Known to FDC; LRF/GLLD Operational
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/23/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Locate Targets SM Task # & Name 061-283-1003 (FO/FIST Ch/FS Sgt) Locate a Target by Polar Plot TRI: 74 References/Notes • SM (FM6-13F) (Pg. 2-12) • FM6-30 (Pg. 3-4)	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FO/ FIST Ch/FS Sgt)	Stationary target in zone of observation detected, classified, and identified	Binoculars	Decision to locate target by polar plot	Initiation of task	Self (FO/ FIST Ch/FS Sgt)		Target detected, correctly classified and identified	Observe performance
				M2 Compass, Paper, Pencil	Perform and record SM 061-283-1001 (Determine Direction within Target Area) to the desired target	Direction to target recorded to the nearest 10 mils	Self (FO/ FIST Ch/FS Sgt)		Direction to target within 100 mils of actual direction expressed to the nearest 10 mils	Measure direction to target and compare values
				GLLD/ LRF	If LRF available, perform task and record SM 061-283-1952 (Operate the LRF) to determine distance to target	Distance in meters to target	Self (FO/ FIST Ch/FS Sgt)		Distance to target accurate to within ± 10 meters (FM)	Measure distance w/ LRF and compare values
					If GLLD available, perform task and record SM 061-274-3973 (Lase an Object w/GLLD)	Range in meters to target and observer to target vertical angle	Self (FO/ FIST Ch/FS Sgt)		Distance (range) to target accurate to within ± xx meters; vertical angle ± xx mils	Measure distance and vertical angle w/GLLD and compare values
				OF Fan, Map	If only map, using OF, orient OF on map. Plot azimuth and via OF and map-terrain analysis, map spot feature where target is located	Visual interpolating of target location in appropriate grid square	Self (FO/ FIST Ch/FS Sgt)		Target located visually in appropriate grid square	Observe and compare output

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; OP Location Known to FDC; LRF/GLLD Operational
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/23/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		Self (FO/ FIST Ch/FS Sgt)	Distance in meters determined by LRF/GLLD	Map, Plotting Equipment	Plot the distance and direction from own location to the target on the map	Target location identified on map	Self (FO/ FIST Ch/FS Sgt)		Target and location associated with correct feature on the map	Observe and compare determined map location
			or Target location on map	Map	or Estimate distance to target	Estimated distance to target			Estimated distance to target within ± 250 meters (SM)	Measure distance and compare values
*If not obvious, disregard.			Target altitude	Map, Binoculars	Determine vertical shift UP or DOWN if obvious,* by map inspection (difference of target elevation and observer elevation)	Vertical shift UP or DOWN. Determined/ NOT required			When determined, vertical shift expressed to the nearest 5 meters (FM)	Measure vertical shift and compare values
				Paper, Pencil	Record direction and distance to target	Direction and distance to target recorded		00:30	Target location determined within 30 seconds (SM)	Measure time from start to task completion

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Digital Comm. Established; LRF/GLLD Operational; Shift Points Identified

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/26/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Locate Targets and Conduct Indirect Fire Missions SM Task # & Name 061-283-1004 (FO/FIST Ch/FS Sgt) Locate a Target by Shift from a Known Point TRI: 74 References/Notes • SM (FM6-13F) • FM6-30 *Visual observation. If GLLD, see Ⓑ, page 2 of 3.	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 5) Weather 6) Terrain 7) High communication load 9) Personal equipmert and/or clothing 10) Operational state	Self (FO/FIST Ch/FS Sgt)	Target in zone of observation detected, classified and identified	Binoculars	Decision to locate target by shift from a known point	Initiation of task	Self (FO/FIST Ch/FS Sgt)	00:00	Target detected; correctly classified and identified	Observe performance
			Known point in zone of observation	Binoculars	Scan zone of observation and identify and select known point in proximity of target location	Known point selected			Shifting point known to both FDC and observer and is in proximity of target location	Observe and compare selected known point from available known point
			Known point data (name, direction, distance, altitude). Target in zone of observation	Terrain Sketch/ Known Point Data (i.e., target list), Binoculars	Ⓐ Measure the angular deviation (lateral shift) in mils from the known point to the OT line with binoculars*	Angular deviation in mils from the known point to the OT line	Self (FO/FIST Ch/FS Sgt)		Angular deviation from the known point to the OT nearest 1 mil	Measure deviation and compare values
				Binoculars, Terrain Sketch/ Known Point Data (i.e., target list)	Determine the direction to the target by adding the angular deviation to the known direction if the target is to the right of the known point or subtracting the angular deviation from the known point direction if the target is to the left of the known point. Record direction to nearest 10 mils	Observer to target (OT) direction			OT direction recorded to the nearest 10 mils	Determine direction and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; LRF/GLLD Operational; Shift Points Identified
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/26/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				GLLD	Ⓑ If GLLD available, perform and record output of SM 061-274-3973 (Lase an Object w/GLLD)	Direction to target			Direction recorded to the nearest 1 mil	Lase target w/GLLD; read and compare values
		Self (FO/ FIST Ch/FS Sgt)	Determine angular deviation in mils (ϕ) and distance (R) to known point	Binoculars, Paper, Pencil, Terrain Sketch/ Target Known Data (i.e., target list)/ GLLD/ LRF	Determine and record lateral shift in meters from the known point to the OT line by: Using mil relation formula, W = Rxϕ, determine W to the nearest 10 meters	Lateral shift (left/right) recorded in meters			Lateral shift accurate to the nearest 10 meters (SM)	Determine lateral shift and compare values
		Self (FO/ FIST Ch/FS Sgt)	Known point distance, if GLLD distance to target. Target in zone of observation	Binoculars, Map	Determine and record distance in meters between known point and target. a) Estimate range from known point distance to target and calculate difference in meters, or b) If GLLD,LRF: Determine difference between actual GLLD range to target and range to known point	The difference between the known point and the target	Self (FO/ FIST Ch/FS Sgt)		Range change (add or drop) from the known point to the target to the nearest ± 100 meters (SM)	Use method observer uses; determine and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Digital Comm. Established; LRF/GLLD Operational; Shift Points Identified

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/26/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
*If no obvious difference is observed, ignore this step.		Self (FO/ FIST Ch/FS Sgt)	Known point altitude, if GLLD. Target and known point vertical angle	Binoculars, GLLD, Map, Paper, Pencil	Determine and record the difference in altitude between known point and target. If obvious,* change (UP/DOWN). If map available, map-spot target location and known point location, and determine difference in meters	Altitude difference in meters between known point and target Location of the target	Self (FO/ FIST Ch/FS Sgt), FDC	00:30	Altitude difference between known point and target to the nearest ± 5 meters (FM, SM) Target located by shift from a known point within 30 seconds	Evaluate if required. Determine and compare values Measure time from start to task completion. Determine accuracy of determined values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Conduct Adjust Fire Missions SM Task # & Name 061-283-1011 (FO/FIST Ch/FS Sgt) Request and Adjust Area Fire Same task as: 061-283-2003 on irregular target 061-283-2205 assault fire 061-283-2103 destruct mission TRI: 74 References/Notes • FM6-30 • SM (FM6-13F) Area Fire is representative and includes initial processes common to other Request and Adjust tasks. See last page (4 of 4).	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self	Target in zone of observation (detected, classified and identified)	Binoculars, GLLD, LRF	Decide to request fire	Initiate task	Self	00:00	Target detected and correctly classified/identified	Observe performance
		Self	Observed target location, classification, identity	Above plus M2 Compass, Map, Plotting Equip., Terrain Sketch, Target List	Perform as appropriate: 061-283-1002 (Grid) 061-283-1003 (Polar) 061-283-1004 (Known point) 061-283-1952 061-283-1953 (LRF) 061-274-3973 061-274-3974 061-274-3976 061-274-3977 (GLLD)	Target location and direction	Self	00:30	Locate target in no more than 30 secs. (SM)	Observe accuracy of data. Observe elapsed time
		Self	Knowledge of: engagement options, desired effect, command guidance. Target data	None	Select method of engagement	Data for selected method • adjustment • trajectory • ammunition • fuze • fire volume • fire distribution	Self		Selected method is appropriate	Observe performance
		Self	Knowledge of firing method and command guidance	None	Select method of firing	Data for selected method • number of guns • interval	Self		Selected method is appropriate	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
*This is the last process common to any Request and Adjust Fire task. The remainder of this analysis is specific to Area Fire. **If initiated by FO, message will be transmitted to FIST for approval. Approval is assumed here.		Self	Target location. Engagement data. Firing data	None	Select* appropriate request for fire	Area Fire selected	Self			
		Self	Decision to request/adjust area fire • target location, • engagement • command guidance	DMD/ FIST DMD	Enter/transmit FM-DMD/FIST (SM Task 061-273-1003)	Message type and FM data transmitted	(FIST)** FDC, Self (FO, FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error	Observe: • FM type • procedure • elapsed time
		FDC	MTO, Shot and Splash messages	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (MSG key)	Observe performance
		Self	Shell burst in zone of observation	Binoculars or GLLD	Observe burst and deviation from target. If GLLD, perform SM 061-274-1979. Determine corrections	Corrections to move subsequent adjustment to the target	Self		Binoculars Determine deviation corrections to the nearest ± 10 meters. Determine range corrections to the nearest ± 50 meters. GLLD Determine deviation and vertical interval to nearest mil and distance (range) to the nearest ± 10 meters	Measure deviations and compare values
		Self	Subsequent corrections	DMD/ FIST DMD	Enter and transmit subsequent adjust data (SM Task 061-273-1003)	Data entered and transmitted	(FIST) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter data within xx seconds w/o procedural error	Measure time to complete. Observe performance
		The above two processes are repeated until burst at ± 50 meters.								

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FISTEquip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
			Shell bursts + 50 meters of target	DMD/ FIST DMD	Observe bursts. Enter and transmit corrections to fire-for-effect	Fire-for-effect data entered and transmitted	(FIST) FDC Self (FO/ FIST Ch/FS Sgt)		Enter and transmit FFE data within 30 seconds w/o procedural error	Determine if FFE appropriate. Measure time to complete subtask
		FDC	MTO, Shot and Splash messages	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (MSG key)	Observe performance
			FFE shell bursts	Binoculars, GLLD, DMD/ FIST DMD	Observe bursts and effect on target. If necessary, determine subsequent adjust and HOB. Determine results effective or	Enter and transmit corrections and FFE			Enter and transmit FFE data within 30 seconds w/o procedural error	Measure and compare values. Determine corrections if appropriate. Measure time and observe operator performance
			FFE shell burst	DMD FIST/ DMD	Observe FFE burst effect on target. Deter-EOM. Enter and transmit EOM	EOM	FDC		Desired effect achieved on target. EOM within 30 seconds after FFE bursts	Observe and evaluate effect on target. Measure elapsed time

Note(s)

The preceding analysis, SM Task 061-283-1011, applies in all respects to the SM tasks listed below with the exception that for the following tasks the first round is evaluated by the FO as a fire-for-effect, and adjustment is made only if desired effect is not achieved:

SM Tasks

061-283-1013 Conduct A Suppression Mission

061-283-1014 Conduct an Immediate Suppression Mission

061-283-1015 Conduct an FFE Mission

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied & Dark; Digital Comm. Established; FO/FIST Equip. Operational

Task Classification:
[ ] Procedural (Fixed, Structured)
[x] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Conduct Adjust Fire Mission SM Task # & Name 061-283-1021 FO/FIST Ch/FS Sgt Request and Adjust Continuous/ Coordinated Illumination TRI: 74 References/Notes • FM6-30 (Chapter 6) • (SM) FM6-13F (Page 2-23) (1)If initiated by FO, message will be transmitted to FIST for review, approval or auto-thru, depending on FIST/DMD subscriber table and mode. This flow assumes FIST approval.	1a) Visibility environmental 2b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FO/ FIST, Ch/FS Sgt)	Indications of possible target in zone of observation, e.g., vehicle lights, vehicle noises, etc.		Decision to request illumination in vicinity of possible target	Initiation of task	Self (FO/ FIST, Ch/FS Sgt)	00:00	None, until task initiated	Observe performance
				Map	Estimate the source of noises or lights and grid location	Estimate of grid location of possible target	Self (FO/ FIST, Ch/FS Sgt		Selected (estimated) grid location within 200 meters of desired location	Estimate target location and compare values
		Self (FO/ FIST, Ch/FS Sgt)	Decision to request illumination estimate of target location, and method of engagement and commander's guidance	DMD/ FIST DMD	Enter and transmit FM data using DMD/FIST (SM Task 061-273-1003) (similar task for FIST DMD)	Message type and FM data transmitted	(FIST)(1) FDC, Self (FO, FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error	Evaluate type of FM selected appropriate, based on type of target and commander's guidance. Measure time to complete subtask and observe operator's procedure
		FDC	DMD/FIST DMD MSG indicator lamp flashing and audible beep	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read MTO contents	Reading of MTO contents	Self (FO, FIST Ch/FS Sgt)		MSG key pressed promptly	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
		FDC	DMD/FIST DMD MSG indicator lamp flashing and audible beep	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read SHOT message	Reading of SHOT. Knowledge that round(s) fired	Self (FO, FIST Ch/FS Sgt)		MSG key pressed promptly	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
		Self (FO/ FIST Ch/FS Sgt)	Illumination flare		Observe illumination flare and determine if HOB, range and deviation correction	Decision on required HOB, range and deviation corrections in relation to desired area of illumination			None until next step	None until corrections specified

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied & Dark; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
(2)Note: Subsequent adjustment procedures repeated until desired HOB and area illuminated.		Self (FO/ FIST Ch/FS Sgt)	Flare burns out during descent/or flare burning on ground		Determine appropriate corrections UP/DOWN to achieve proper HOB	Decision--HOB corrections			None until specified	None until corrections specified
			Flare not within 200 meters deviation or within desired area	Binoculars	Determine appropriate deviation and range corrections	Decision—deviation and range corrections			None until specified	None until corrections specified
		Self (FO/ FIST Ch/FS Sgt)	Determined corrections	DMD/ FIST DMD	Enter and transmit subsequent adjust data (SM Task 061-273-1003) (similar task for FIST DMD)	Subsequent adjust data entered and transmitted	(FIST)(2) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter and transmit subsequent adjust data within TBD seconds w/o procedural error	Determine corrections and compare values. Measure time to complete subtask and observe operator's performance
		Self (FO/ FIST Ch/FS Sgt)	Target in zone of observation detected, classified, and identified	Binoculars/ GLLD w/TAS-4	Decision to request artillery fire to attack target	Decision to locate target			Target detected correctly classified and identified	Observe performance
				Map, M2 Compass, Plotting Equip., Binoculars, Terrain Sketch, Target List	Perform appropriate SM Task 061-283-1002 (Locate target by grid coord) or 061-283-1003 (Locate target by polar plot) or 061-283-1004 (Shift from known point)	Target location and direction		00:30	Target located within 30 seconds	Measure time from start to completion of this subtask for selected SM; determine accuracy of determined values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied & Dark; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		Self (FO/ FIST Ch/FS Sgt)	Decision to request and adjust area fire and coordinated illumination, target location, and method of engagement and commander's guidance	DMD/ FIST DMD	Enter and transmit FM data using DMD/FIST (SM Task 061-273-1003) (similar task for FIST DMD)	Message type and FM data transmitted	(FIST)(1) FDC, Self (FO, FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error	Evaluate type of FM selected appropriate, based on type of target and commander's guidance. Measure time to complete subtask and observe operator's procedure
		FDC	DMD/FIST DMD MSG indicator lamp flashing and audible beep	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read MTO contents	Reading of MTO contents	Self (FO, FIST Ch/FS Sgt)		MSG key pressed promptly	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
		FDC	DMD/FIST DMD MSG indicator lamp flashing and audible beep	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read SHOT message	Reading of SHOT. Knowledge that round(s) fired	Self (FO, FIST Ch/FS Sgt)		MSG key pressed promptly	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
(3)SPLASH message is at the option of the observer. This flow assumes SPLASH desired.		FDC	DMD/FIST DMD MSG indicator lamp flashing and audible beep	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read SPLASH message(3)	Reading of SPLASH message, Knowledge that rounds will burst within 5 seconds	Self (FO, FIST Ch/FS		MSG key pressed promptly	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
		Self (FO/ FIST Ch/FS Sgt)	Shell burst in zone of observation	Binoculars	Observe bursts. Measure deviation from bursts to target	Subsequent corrections to move subsequent adjustment to the target	Self (FO/ FIST Ch/FS Sgt)		Determine deviation corrections to the nearest ± 10 meters. Determine range corrections to the nearest ± 50 meters	Measure deviations and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied & Dark; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
		Self (FO/ FIST Ch/FS Sgt)	Subsequent corrections	DMD/ FIST DMD	Enter and transmit subsequent adjust data (SM Task 061-273-1003) (similar task for FIST DMD	Subsequent adjust data entered and transmitted	(FIST)(2) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter and transmit subsequent adjust data within TBD seconds w/o procedural error	Measure time to complete subtask and observe operator's performance
			Shell bursts ± 50 meters of target	DMD/ FIST DMD	Observe bursts. Enter and transmit corrections to fire-for-effect. If time desired, request fuze time	Fire-for-effect data entered and transmitted	(FIST)(1) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter fire-for-effect within ± 50 meters of target. Enter and transmit FFE data within TBD seconds w/o procedural error	Determine FFE appropriately. Measure time to complete subtask and observe operator's performance
		FDC	Shell bursts ± 50 meters of target	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read SHOT message	Reading of SHOT. Knowledge that round(s) fired	(FIST)(1) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter fire-for-effect within ± 50 meters of target. Enter and transmit FFE data within TBD seconds w/o procedural error	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC
		FDC	Shell bursts ± 50 meters of target	DMD/ FIST DMD	Observe lamp and/or hear beep. Press MSG key and read SPLASH message	Reading of SPLASH message. Knowledge that rounds will burst within 5 seconds	(FIST)(1) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter fire-for-effect within ± 50 meters of target. Enter and transmit FFE data within TBD seconds w/o procedural error	Observe MSG key pressed promptly; MSG indicator lamp and beep off. MSG ACK to FDC

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied & Dark; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		Self (FO/ FIST Ch/FS Sgt)	FFE shell bursts	Binoculars DMD/ FIST DMD	Observe bursts and effect on target. If necessary, sketch using subsequent adjust (to include HOB corrections, if desired). Determine results effective or	Enter and transmit corrections and FFE			Enter and fire-for-effect corrections. Transmit FFE data within TBD seconds w/o procedural error after bursts	Measure and compare values. Determine corrections appropriate. Measure time and observe operator's performance
					Observe FFE burst effect on target. Determine end of mission (EOM)	*Decision to EOM*			*Desired effect achieved on* target	Observe and evaluate effect on target
		Self (FO/ FIST Ch/FS Sgt)	Decision to EOM	DMD/ FIST DMD	Enter and transmit EOM and results. (Enter only final refinement data [deviation, vertical interval and range] if necessary)	EOM results transmitted	(FIST) FDC, Self (FO, FIST Ch/FS Sgt)		EOM (w/refinement data) transmitted within TBD seconds after FFE bursts w/o procedural error	Measure time and observe operator's performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO
Prequisites: OP Occupied; Digital Comm. Established; AN/GVS-5 Prepared for Operation
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/19/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Conduct Adjust Fire Missions SM Task # & Name 061-283-1952 (FO) Operate the Laser Range Finder (LR) AN/GVS-5 TRI: 65 References/Notes • FM6-30 (Pg. 6-27) • (SM) FM6-13F (Pg. 2-31) *If "multiple target" warning is observed in eyepiece, it indicates that more than one return signal was received.	1a) Visibility environmental 1b) Visibility equipment 2a) Noise environmental 2b) Noise equipment 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FO)	Target in zone of observation	AN/ GVS-5	Locate a target for which distance to target data is desired	Initiation of task	Self (FO)	00:00	Task is initiated promptly when target identified	Observe performance
				AN/ GVS-5	Remove laser range finder (LRF) lens cover. Set PWR to ON	LRF lens cover removed, POWER ON	Self (FO)		LRF lens cover removed and POWER ON accomplished without delay	Observe time to POWER ON
				AN/ GVS-5	Hold the LRF steady (standing, supported or prone position) sight through the eyepiece and align the center circle of the reticle pattern on the desired target	Target aligned in center circle of LRF reticle	Self (FO)		Target aligned promptly and accurately in the center circle of the LRF reticle	Observe performance
				AN/ GVS-5	Observe target properly aligned (lased), and read the distance to target in meters in the range-to-target window (in eyepiece).* Set the PWR switch to OFF	Distance to target determined. Distance no longer displayed	Self (FO)		Distance to target accurate to within ± 10 meters (FM)	Measure the distance from the FO location to target and compare readings
				AN/ GVS-5 Map of Target Area	Compare the displayed range with FO's map-terrain analysis and estimate of range to target	Determination that range to target is accurate/not accurate	Self (FO)		Correct determination that range to target is accurate/not accurate	Compare LRF range to map-terrain analysis range

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO

Prequisites: OP Occupied
Digital Comm. Established
AN/GVS-5 Prepared for Operation

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/19/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
				AN/ GVS-5	If in doubt about LRF range to target, make additional LRF range determinations until three consistent readings obtained by repeating above LRF PWR ON and lasing procedures	Three consistent range-to-target determinations	Self (FO)		Three consistent LRF range-to-target determinations accurate to ± 10 meters with minimum delay	Observe time to complete 3 determinations. Compare lased range to actual

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO
Prequisites: OP Occupied; M2 Compass Declinated; Digital Comm. Established; AN/GVS-5 Prep'd for Operations
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/20/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Locate Targets SM Task # & Name 061-283-1959 (FO) Determine Location with the Laser Range Finder (LR) AN/GVS-5 TRI: 65 References/Notes • SM (FM6-13F) (Pg. 2-35)	1a) Visibility environmental 1b) Visibility equipment 5) Weather 6) Terrain 9) Personal equipment and/or clothing 10) Operational state	Self (FO)	Two known terrain features that can be lased w/ LRF from OP	AN/ GVS-5	Need to determine observer location with the aid of AN/GVS-5 Laser Ranger Finder (LRF)	Initiation of task	Self (FO)	00:00	Task initiated promptly	Observe performance
				AN/ GVS-5, Paper, Pencil	Measure the distance to each of the two known points by performing SM 061-283-1952 (Operate the LRF) and record the values	Distance in meters to two known points from FO location recorded	Self (FO)		Distance to each of the known points accurate to within ± 10 meters (FM)	Measure the distance from the FO location to each of the known points and compare the values
				M2 Compass	Using the compass, measure the direction (azimuth) to each of the above known points and record the values	Direction in mils to two known points from the FO location recorded	Self (FO)		Direction to each of the known points accurate to within ± xx mils	Measure the direction from the FO location to each of the known points and compare the values
		Self (FO)	Recorded direction in mils to known points	Map of Zone of Observation, Plotting Equip-	Determine the back-azimuth to each of the known point directions by: Subtracting 3200 ₥ if direction is between 3200 ₥ and 6400 ₥. Adding 3200 ₥ if direction is between 0 and 3199 ₥	Determined back-azimuths for each of the known points	Self (FO)		Back-azimuths to be determined to within ₥ mils	Perform the calculation and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO
Prequisites: OP Occupied; M2 Compass Declinated; Digital Comm. Established; AN/GVS-5 Prep'd for Operations
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/22/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Plotting Equipment, Pencil Map	Accurately place a plotting pin in each of the known points. Orient the protractor parallel to N-S Grid while placing the index over one of the known points	Each known point plotted. Protractor oriented N-S on known point in the direction of the back-azimuth	Self (FO)		Known points plotted accurately. Protractor oriented properly	Observe plotted known points and evaluate protractor orientation
				Plotting Equipment, Pencil, Map	Read the protractor azimuth scale and lightly mark the back azimuth to the known point. Remove the protractor	A mark (point) indicated on the map as the back azimuth to known point	Self (FO)		Back-azimuth indicated accurately on the map. (Should be a light pencil point mark.)	Plot back-azimuth and compare
				Plotting Equipment, Pencil, Map	Draw a line from the plotted known point through the back-azimuth point	A line drawn from known point through back-azimuth mark	Self (FO)		Line accurate and straight drawn between known point and back-azimuth mark	Observe line accurate and straight drawn as required
		Self (FO)	Recorded distance to known points	Plotting Equipment, Map, Pencil	Accurately measure the recorded distance from the plotted known point along the back-azimuth line and mark where on the line the desired distance is measured	Distance from known point to FO location accurately indicated	Self (FO)		Distance to FO location accurately measured from known point	Measure distance and compare
			Repeat above procedure for second known point to determine FO location.							

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSES

Subsystem: FIST

Section Position(s): FO

Prequisites: OP Occupied; M2 Compass Declinated; Digital Comm. Established; AN/GVS-5 Prep'd for Operations

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/22/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
*The coordinates must be plotted for each of the unknown points from the two known points data (back-azimuth and distance). **If more than ± 50 meters, repeat the task.					Plot coordinates of the unknown point (FO location)*	Coordinates of FO location			The coordinates of the unknown point determined from the second known point must be within ± 50 meters of those determined from the first point**	Plot the points and measure the accuracy
GENERAL NOTE:	The FO can also measure the distance and direction to the known points and transmit these data to FDC who can determine his location and transmit coordinates in an OBSVR LOC message.									

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Conduct Indirect Fire Missions	1a) Visibility environmental 1b) Visibility equipment	Self	Target close to maneuver element or company assigned a FPF	Binoculars, GLLD, LRF	Decide to request fire	Initiate task	Self	00:00	Target detected and correctly classified/identified	Observe performance
SM Task # & Name 061-283-2001 Request and Adjust Area Fire Using Creeping Procedures 061-283-2002 Request and Adjust Final Protective Fires (FPF) TRI: 74 References/Notes • (SM) FM6-13F (Pgs. 2-240, 2-248) • FM6-30 (Chapter 6)	3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self	Observed target location, classification, identity	Above plus M2 Compass, Map, Plotting Equip., Terrain Sketch, Target List	Perform as appropriate: 061-283-1002 (Grid) 061-283-1003 (Polar) 061-283-1004 (Known point) 061-283-1952 061-283-1953 (LRF) 061-274-3973 061-274-3974 061-274-3976 061-274-3977 (GLLD)	Target location and direction	Self	00:30	Locate target in no more than 30 secs. (SM)	Observe accuracy of data. Observe elapsed time
		Self	Knowledge of: engagement options, desired effect, command guidance. Target data	None	Select method of engagement	Data for selected method • adjustment • trajectory • ammunition • fuze • fire volume • fire distribution	Self		Selected method is appropriate	Observe performance
		Self	Knowledge of firing method and command guidance	None	Select method of firing	Data for selected method • number of guns • interval	Self		Selected method is appropriate	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
*This is the last process common to any Request and Adjust Fire task. The remainder of this analysis is specific to Area Fire. **If initiated by FO, message will be transmitted to FIST for approval. Approval is assumed here.		Self	Target location. Engagement data. Firing data	None	Select* appropriate request for fire	Area Fire selected	Self			
		Self	Decision to request/adjust area fire • target location, • engagement • command guidance	DMD/ FIST DMD	Enter/transmit FM-DMD/FIST (SM Task 061-273-1003)	Message type and FM data transmitted	(FIST)** FDC, Self (FO, FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error	Observe: • FM type • procedure • elapsed time
		FDC	MTO, Shot and Splash messages	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (MSG key)	Observe performance
		Self	Shell burst in zone of observation	Binoculars or GLLD	Observe burst and deviation from target. If GLLD, perform SM 061-274-1979. Determine corrections	Corrections to move subsequent adjustment to the target	Self		Binoculars Determine deviation corrections to the nearest + 10 meters. Determine range corrections to the nearest ± 50 meters. GLLD Determine deviation and vertical interval to nearest mil and distance (range) to the nearest + 10 meters	Measure deviations and compare values
		Self	Subsequent corrections	DMD/ FIST DMD	Enter and transmit subsequent adjust data (SM Task 061-273-1003)	Data entered and transmitted	(FIST) FDC, Self (FO/ FIST Ch/FS Sgt)		Enter data within xx seconds w/o procedural error	Measure time to complete. Observe performance
		The above two processes are repeated until burst at ± 50 meters.								

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FISTEquip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
			Shell bursts + 50 meters of target	DMD/ FIST DMD	Observe bursts. Enter and transmit corrections to fire-for-effect	Fire-for-effect data entered and transmitted	(FIST) FDC Self (FO/ FIST Ch/FS Sgt)		Enter and transmit FFE data within xx seconds w/o procedural error	Determine if FFE appropriate. Measure time to complete subtask
		FDC	MTO, Shot and Splash messages	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (MSG key)	Observe performance
			FFE shell bursts	Binoculars, GLLD, DMD/ FIST DMD	Observe bursts and effect on target. If necessary, determine subsequent adjust and HOB. Determine results effective or	Enter and transmit corrections and FFE			Enter and transmit FFE data within xx seconds w/o procedural error	Measure and compare values. Determine corrections if appropriate. Measure time and observe operator performance
			FFE shell burst	DMD FIST/ DMD	Observe FFE burst effect on target. Deter-EOM. Enter and transmit EOM	EOM	FDC		Desired effect achieved on target. EOM within xx seconds after FFE bursts	Observe and evaluate effect on target. Measure elapsed time

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: Op Occupied; Digital Comm. Established; FO/FIST Equip. Operational; Limited Visibility
Task Classification: [ ] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Conduct Indirect Fire Missions SM Task # & Name 061-283-2004 (FO/FIST Ch/FS Sgt) Request and Adjust Area Fire Using Sound Adjustment Procedures TRI: 89 References/Notes • (SM) FM6-13F Pg. 2-250 - 2-251 • FM 6-30, Pg. 6-20	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	Self (FO/ FIST Ch/FS Sgt)	Hear possible target noises, e.g., weapons firing, vehicles or troop movements		Decision to request artillery fire	Initiation of task	Self (FO/ FIST Ch/FS Sgt		Detect/orient sound	Observe performance
				Map M2 Compass	Estimate target location by estimating distance and direction	Estimated direction and distance to target location	Self (FO/ FIST Ch/FS Sgt		Direction expressed to the nearest ± 10 mils within 200 meters of actual direction Distance expressed to the nearest ± 100 meters	Observe and compare values
		Self	Knowledge of: engagement options, desired effect, command guidance. Target data	None	Select method of engagement	Data for selected method • adjustment • trajectory • ammunition • fuze • fire volume • fire distribution	Self		Selected method is appropriate	Observe performance
		Self	Knowledge of firing method and command guidance	None	Select method of firing	Data for selected method • number of guns • interval	Self		Selected method is appropriate	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 3/24/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
*This is the last process common to any Request and Adjust Fire task. The remainder of this analysis is specific to Area Fire. **If initiated by FO, message will be transmitted to FIST for approval. Approval is assumed here.		Self	Target location. Engagement data. Firing data	None	Select* appropriate request for fire	Area Fire selected	Self			
		Self	Decision to request/adjust area fire • target location, • engagement • command guidance	DMD/ FIST DMD	Enter/transmit FM-DMD/FIST (SM Task 061-273-1003). Alert FDC: sound adjustment	Message type and FM data transmitted	(FIST)** FDC, Self (FO, FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error	Observe: • FM type • procedure • elapsed time
		FDC	MTO, Shot and Splash messages	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (MSG key)	Observe performance
		Self (FO/ FIST Ch/FS Sgt)	Sound and/or flash of burst		Determine distance to burst by measuring seconds it takes sound of burst to reach observer from expected time of impact. (Number of seconds X 350 meters = estimated distance)	Estimated distance to target			Distance estimated by multiplying # of seconds from impact to sound reaching observer by 350 meters	Observe performance
				M2 Compass	Determine direction to target by measuring direction to burst and compare to estimated direction to target and determine lateral shift	Estimated shift in meters to target from burst			Lateral deviation estimated by difference of direction (burst and target location). Apply $W = \frac{R}{M}$ for corrections	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; LRF Operational; Observer Location Known to FDC
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 7/26/84
Analyst:

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Conduct Indirect Fire Missions SM Task # & Name 061-283-2005 (FO/FIST Ch/FS Sgt) Determine Direction or Locate an Unknown Point on the Ground by the Indirect Fire Technique TRI: 74 References/Notes • (SM) FM 6-13F (Pg. 2-252) • FM 6-30	1) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing	Self (FO/ FIST Ch/FS Sgt)	Permanent/ semipermanent object near center of sector. Observer unable to orient to determine grid location of point		Need to determine grid location of unknown point near center of sector	Initiation of task	Self (FO/ FIST Ch/FS Sgt)		None, until task initiated	Observe performance
				Map, M2 Compass	Determine direction (SM 061-283-1001)	Direction to known point			Direction to point expressed to nearest ± 10 mils within ± 100 mils of actual direction	Measure and compare values
				LRF	Determine distance with LRF 061-283-1952	Distance in meters to known point	Self (FO/ FIST Ch/FS Sgt)		Distance accurate to ± 10 meters	Measure and compare values
				DMD/ FIST DMD	Perform SM 061-273-1003 or equivalent FIST DMD task (enter and transmit FM data)	Transmit FM data which includes work center of sector and type of shell, e.g., WP			Call for fire data complete w/o procedural error	Observe performance
			SHOT and SPLASH messages followed by burst	DMD/ FIST DMD	Press MSG key/ read each message	Message content	Self (FO, FIST Ch/FS Sgt)		Respond promptly (30 secs.)	Observe performance
				Binoculars, LRF, DMD, FIST DMD	Determine deviation and range corrections to move burst on target (Repeat adjustment procedure until FFE achieved)	Enter and transmit subsequent adjustment data	Self (FO, FIST Ch/FS Sgt), FDC		Adjustment continued until FFE complete	Observe performance
			FFE complete	DMD, FIST DMD	Request and receive grid coordinates of point	Grid coordinates of object fired upon	FDC		Record grid location on map terrain sketch, etc., and use to make shifts to subsequent targets	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Conduct FFE Mission SM Task # & Name 061-283-2021 Conduct an Immediate Smoke Mission 061-283-2022 Build and Maintain a Quick Smoke Screen TRI: 74 References/Notes • (SM) FM6-13F (Pgs. 2-254, 2-263) • FM6-30	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 5) Weather 6) Terrain 7) High communication load	Self	Suppressive fires ineffective or need to deny enemy observation		Decision to conduct immediate smoke/quick smoke	Initiation of task	Self FO/ FIST Ch/FS Sgt	00:00	None until task initiated	Observe performance
			Type of wind conditions. Possible adjing point for smoke	Binoculars	Observe wind conditions in area to be obscured and determine type of wind (cross, head or tail wind)	Type of wind condition in area to be obscured	Self FO/ FIST Ch/FS Sgt		Interpret wind correctly	Observe performance
					Select an adjusting point based on wind conditions. Tail wind —at least 200 meters short of target on the MT line	Selection of an adjusting point for smoke to obscure enemy in relation to MT line	Self FO/ FIST Ch/FS Sgt		Selected adjusting point appropriate for wind conditions and desired obscuration effects	Evaluate appropriateness of selected point
			Previously fired suppressive rounds and/or selected adjusting point	Binoculars/ LRF/ GLLD, Map, Target List	Determine location of adjusting point by: 061-283-1002 (Grid) 061-283-1003 (Polar) 061-283-1004 (Known point) 061-283-1952 061-283-1953 (LRF) 061-274-3973 061-274-3974 061-274-3976 061-274-3977 (GLLD) as appropriate	Adjusting point location	Self (FO/ FIST Ch/FS Sgt)		Adjusting point location accurately determined within xx seconds	Measure time required to accurately locate adjusting point

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Digital Comm. Established; FO/FIST Equip. Operational

Task Classification:
[ ] Procedural (Fixed, Structured)
[x] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
*If initiated by FO, message will be transmitted to FIST for review/ approval.			Adjusting point location and desired effects	DMD/ FIST DMD	Enter and transmit FM data using DMD/FIST DMD (SM 061-273-1003) (similar task for FIST DMD)	Message type and FM data transmitted	(FIST)* FDC, Self (FO/ FIST Ch/FS Sgt)		Enter and transmit appropriate FM data within 90 seconds w/o procedural error (150 seconds for quick smoke from identification to transmittal)	Evaluate FM message selected, completion of data fields. Measure time
		FDC	MTO, SHOT and SPLASH messages	DMD/ FIST DMD	Read each message	Knowledge of message contents	Self (FO/ FIST Ch/FS Sgt)		Messages processed promptly	Observe performance
		Self (FO/ FIST Ch/FS Sgt)	Shell burst(s)	Binoculars, GLLD	Observe burst(s). If immediate smoke, determine effectiveness. If quick smoke, HE adjust, determine required corrections	Subsequent corrections, if any	Self (FO/ FIST Ch/FS Sgt)		If immediate smoke, obscure target before third round (SM). If quick smoke, transmit corrections for HE until near adjusting point	Observe burst effects and subsequent adjustments. Evaluate performance
			Burst(s) at or near adjusting point		Enter and transmit FFE smoke data	FFE smoke data transmitted	(FIST)* FDC, Self (FO/ FIST Ch/FS Sgt)		Appropriate FFE within xx seconds w/o procedural error	Observe performance and measure time
			MT line effectively obscured	Binoculars, DMD/ FIST DMD	Observe effectiveness of smoke. Enter and transmit EOM	EOM and results transmitted	(FIST)* FDC Self (FO/ FIST Ch/FS Sgt)		When smoke effective, transmit EOM	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Position Known
Digital Comm. Established
FO/FIST Equip. Operational
Task Classification:
[x] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)
Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Conduct Precision Registration Quick and Time SM Task # & Name 061-283-2102 Conduct an Impact and Time Registration TRI: 74 References/Notes	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FDC	Message to conduct impact and time registration on known RP	DMD/ FIST DMD	Read message contents	Initiation of task	Self		Message processed promptly	Observe performance
		Self	RP location in zone of observation	Binoculars, Terrain Sketch/ Target List, M2 Compass	Observe and locate RP. Using compass, measure and determine observer-target (OT) direction	OT direction to target	Self		OT direction within xx mils of actual direction	Measure and compare values
				GLLD/ LRF	Using LRF/GLLD determine OT Distance and OT factor 061-283-1952 (LRF) 061-274-3973 (GLLD)	OT distance and OT factor	Self		OT distance measured to nearest 100 meters; OT factor to nearest 100 meters	Measure and compare values
		Self	Target location; OT direction	DMD/ FIST DMD	Enter REG data using appropriate message format and transmit data	REG data entered on DMD/ FIST DMD and transmitted	FDC		Registration data entered and transmitted w/o procedural error	Observe performance
*SPLASH message optional		FDC	SHOT and SPLASH* messages	DMD/ FIST DMD	Read message contents	Knowledge of message contents	Self		Messages processed promptly	Observe performance
		Self	Shell burst	Binoculars	Observe burst and measure deviation (OT factor) and determine range correction	Corrections required to bring round onto OT line prior to splitting 200-meter bracket	Self		Range and deviation correction accurately determined w/o procedural error (SM)	Measure and compare values

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FO/FIST Ch/FS Sgt
Prequisites: OP Occupied; Position Known
Digital Comm. Established
FO/FIST Equip. Operational
Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
			Deviation and range corrections required to bring burst on OT line	DMD/ FIST DMD	Enter and transmit REG corrections	Corrections entered and transmitted	FDC		Correction data entered and transmitted w/o procedural error	Observe performance
		FDC	SHOT and SPLASH message	DMD/ FIST DMD	Read message contents	Knowledge of message contents	Self		Messages processed promptly	Observe performance
			Shell burst	Binoculars	Observe burst; determine range corrections to split 100-meter bracket	Range corrections to split 100-meter bracket	Self		Range corrections accurately determined w/o procedural error (SM)	Measure and compare values
			Range corrections required to split 100-meter bracket	DMD/ FIST DMD	Enter and transmit REG range corrections	Corrections entered and transmitted	FDC		Correction data entered and transmitted w/o procedural error	Observe performance
		FDC	SHOT and SPLASH messages	DMD/ FIST DMD	Read message contents	Knowledge of message contents	Self		Messages processed promptly	Observe performance
The above four processes are repeated as required to refine the burst location to ± meters of target										
*If graze or high air, request correction until desired height obtained.		Self	Shell burst		Determine air burst at desired height*	Desired time of HOB	Self		HOB achieved	Observe performance
			Desired HOB achieved	DMD/ FIST DMD	Enter and transmit "three rounds, repeat"	3 rounds requested	FDC		Transmit request w/o delay and w/o procedural error	Observe performance
		FDC	SHOT message	DMD/ FIST DMD	Read SHOT message	Knowledge of SHOT message	Self		Message processed promptly	Observe performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FO/FIST Ch/FS Sgt

Prequisites: OP Occupied; Position Known
Digital Comm. Established
FO/FIST Equip. Operational

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/27/84

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		Self	Observe three bursts		Determine burst refinement data, if any, to achieve 20-meter height of burst	Required burst refinement data, if any	Self		Refinement data correct to obtain 20-meter HOB	Compare values
			HOB refine-ment values and EOM	DMD/ FIST DMD	Enter refinement data and record as time registra-tion	Refinement data and EOM data transmitted	FDC		Precision impact and time registration performed w/o procedural error (SM)	Observe and evaluate performance

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST

Section Position(s): FIST Ch/FS Sgt

Prequisites: FIST HQ Established; Digital Comm. Established; FIST has FO's in Review, FRA or Auto Mode

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____

Analyst: ____

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
SM Task # & Name TBD Control/Coordinate FM Data Using FIST DMD* (FIST) TRI: Not Determined References/Notes • Fire Support Team Digital Message Device AN/PSG-5, Operator's Manual (Draft) • O & O Plan FIST DMD • This DMD Task Supports Several Functions *FIST DMD boarded tasks not available	1) Visibility—darkness 3) Moving vehicle 4) Temperature/humidity 5) Extreme weather (snow, rain, sleet) 6) Type of terrain (flat, hilly, rolling, mountainous) 7) High communications load 9) Personal equipment and clothing (gloves, mask) 10) Operational state (enemy action, target load, commander's guidance	FO	Fire mission related messages	FIST DMD	**Review Mode** Press message key	Message content displayed and read	Self	00:00	MSG key is pressed promptly (Draft-OM)	Observe message displayed promptly
					Determine to approve displayed message	Decision to approve message	Self		Decision to approve message made promptly (Draft-OM)	
				FIST DMD	Press XMIT key	ACK indicator lighted	FO Self		XMIT key pressed without delay (Draft-OM)	Observe XMIT key pressed promptly
					OR Determine to disapprove displayed message	Decision to disapprove message	Self		Decision to disapprove message made promptly (Draft-OM)	
				FIST DMD	Readdress message to FO	Readdressed message	FO Self		Readdress message without error (Draft-OM)	Observe readdressed message
				FIST DMD	Press XMIT key	ACK indicator lighted	FO Self		XMIT key pressed without delay (Draft-OM)	Observe XMIT key pressed promptly
				FIST DMD	**AUTO Mode** No FIST action required	No FIST action required				
				FIST DMD	**FRA Mode** Press message key	Message content displayed and read	Self		MSG key is pressed promptly (Draft-OM)	Observe message displayed promptly
					Determine to approve displayed message	Decision to approve message	Self		Decision to approve message made promptly (Draft-OM)	
				FIST DMD	Press XMIT key	ACK indicator lighted	FO Self		XMIT key pressed without delay (Draft-OM)	Observe XMIT key pressed promptly
					OR Determine to disapprove displayed message	Decision to disapprove message	Self		Decision to disapprove message made promptly (Draft-OM)	
				FIST DMD	Readdress message to FO	Readdressed message	FO Self		Readdress message without error (Draft-OM)	Observe readdressed message
				FIST DMD	Press XMIT key	ACK indicator lighted	FO Self		XMIT key pressed without delay (Draft-OM)	Observe XMIT key pressed promptly

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FIST
Section Position(s): FIST Ch/FS Sgt
Prequisites: FIST HQ Established; Digital Comm. Established; FIST has FO's in Review, FRA or Auto Mode
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: _____
Analyst: _____

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		FDC	Fire mission related mes-sages	FIST DMD	**AUTO Mode** No FIST action required	No FIST action required				
				FIST DMD	**Review Mode** Press message key	Message content displayed and read	Self		MSG key is pressed promptly (Draft-OM)	Observe message dis-played promptly
					Reroute message to appropriate FO; press XMIT key	ACK indicator lighted	FO Self		Message rerouted correctly and XMIT key pressed without delay (Draft-OM)	Observe XMIT key pressed promptly
				FIST DMD	**FRA Mode** No FIST action required	No FIST action required				

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data SM Task # & Name 061-279-2002 061-279-2003 (BCS Oper.) 061-279-2004 Determine Firing Data Using the BCS (Area Mission) for a Target Located by Grid Coordinates, Polar Plot, Shift from a Known Point TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Advance Copy, Chapter 3, Pg. 3-18)	2a) Noise environmental 2b) Noise equipment 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FO/ FIST	Audible alarm on. FIRE MSN lamp on	BCS	Observe alarm and FIRE MSN lamp or BCS	Initiation of task	Self	00:00	Message alarm and FIRE MSN lamp observed	Observe performance
				BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; RFAF message displayed	Self		ALARM ACK key and RCVD MSG keys are pressed promptly	Observe alarm off and message displayed
				BCS	Announce displayed message contents (including Grid Coordinates, Polar Plot and Shift from a known point) to FDO and Chart Operator	Displayed message contents announced to FDO and Chart Operator	FDO, Chart Operator, Self		Displayed message correctly repeated	Compare displayed message to repeated message
		FDO	Issued Fire Order	BCS	Make appropriate entries in accordance with FDO requested action	Message reviewed, FM; RFAF reflects FDO fire order	FDO, Self		Message content correctly entered	Compare Fire Order content with displayed RFAF
				BCS	Review message and press EXEC key	Displayed gun orders on BCS	FDO, Self		EXEC key pressed promptly when desired FM; RFAF is correct	Compare displayed orders with Fire Order
				BCS	Review Gun Orders for completeness/accuracy	Determination that Gun Orders are complete/ accurate	Self, FDO		Gun Orders reflect FDO's Fire Order	Compare displayed Gun Orders to Fire Order request
				BCS	Press XMIT key to transmit Gun Orders to Howitzer Section	Fire commands transmitted to Howitzer Section; polling status displayed on BCS; FM; MTO message displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed; FM; MTO message displayed	Observe polling status and FM; MTO

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		How Sec	Gun ACK	BCS	Monitor gun polling status	DATA/ACK indication received from How Sec	Self, FDO		Observe ACK indication on BCS display	Observe ACK indication on BCS
				BCS	Press XMIT key to transmit FM; MTO message	FM; MTO message transmitted to FO; FM; FOCMD: SHOT message displayed	FO		FM; MTO message transmitted to FO; FM; FOCMD: SHOT message displayed	Observe FM; FOCMD: SHOT message displayed
		How Sec	Gun READY and SHOT	BCS	Monitor gun ready/firing status	READY indication and FIRE SHOT indication received from How Sec	Self, FDO		Observe READY and FIRE SHOT indication on BCS display	Observe READY and FIRE SHOT indication on BCS
				BCS, Stop Watch	Press XMIT key to transmit FM; FOCMD: SHOT message; start Splash countdown	FM; FOCMD: SHOT message transmitted to FO; FM; FOCMD: SPLASH message displayed; countdown initiated	FO, Self		SHOT message transmitted promptly	Observe SHOT message transmitted
				BCS, Stop Watch	Observe time of flight 10 seconds to impact; press XMIT key 10 seconds before impact of round to transmit FM; FOCMD: SPLASH message	FM; FOCMD: SPLASH message transmitted to FO; FM; RFAF message displayed with ballistic computations entered in appropriate fields	FO, FDO		XMIT key pressed 10 seconds before impact; FM; RFAF message displayed	Observe XMIT key pressed correctly
Note: When displayed messages do not reflect Fire Order, BCS Operator makes appropriate manual entries in message field(s).		FO/ FIST	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; SUBS message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe Alarm and FIRE MSN Lamp off
				BCS	Review message and interact with FDO per SOP	Message reviewed and announced to FDO	FDO, Self		Message content correctly repeated	Compare announced message content with displayed message content

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				BCS	Press EXEC key	Displayed Gun Orders on BCS	FDO, Self		EXEC key pressed promptly when FM; SUBS correct	Compare displayed order with requested Fire Order
				BCS	Review Gun Orders for completeness/accuracy	Determination that Gun Orders are complete/accurate	Self, FDO		Gun Orders reflect Fire Order	Compare displayed Gun Orders with requested Gun Orders
				BCS	Press XMIT key to transmit Fire Commands to Howitzer Section	Fire commands transmitted to How Sec; polling status displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed	Observe polling status
		How Sec	Gun ACK	BCS	Monitor gun polling ACK status	DATA/ACK indication received from How Sec	Self, FDO		Observe ACK status on display	Observe ACK indication on BCS
		How Sec	Gun READY and SHOT	BCS	Monitor gun ready/firing status	READY indication and FIRE SHOT indication received from How Sec	Self, FDO		Observe READY and FIRE SHOT indication on BCS display	Observe READY and FIRE SHOT indication on BCS
				BCS, Stop Watch	Press XMIT key to transmit FM; FOCMD: SHOT message; start Splash countdown	FM; FOCMD: SHOT message transmitted to FO; FM; FOCMD: SPLASH message displayed; countdown initiated	FO, Self		Shot message transmitted promptly	Observe SHOT message transmitted
				BCS, Stop Watch	Observe time of flight 10 seconds to impact; press XMIT key 10 seconds before impact of round to transmit FM; FOCMD: SPLASH message	FM;FOCMD: SPLASH message transmitted to FO; FM; SUBS message displayed with ballistic computations entered in appropriate fields	FO, FDO		XMIT pressed 10 seconds before impact	Observe XMIT key pressed correctly

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		FO/ FIST	Audible alarm on; FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	Fire For Effect phase message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe alarm and FIRE MSN Lamp off
				BCS	Review message and interact with FDO per SOP	Message reviewed and announced to FDO	FDO		Message content correctly repeated	Compare announced content with displayed message content
				BCS	Press EXEC key	Gun Orders displayed on BCS	Self, FDO		EXEC key pressed promptly	Compare displayed order with requested order
				BCS	Press XMIT key to transmit Gun Orders to How Sec	Gun Orders transmitted to How Sec; polling status displayed on BCS; FM; MTO message displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed; FM; MTO message displayed	Observe polling status and FM; MTO
		How Sec	Gun ACK	BCS	Monitor gun polling ACK status	DATA/ACK indication received from How Sec	Self, FDO		Observe ACK status on BCS display	Observe ACK indication on BCS
				BCS	Press XMIT key to transmit FM; MTO message	FM; MTO message transmitted to FO; FM; FOCMD: SHOT message displayed	FO		FM; MTO message transmitted to FO; FM; FOCMD: SHOT message displayed	Observe FM; FOCMD: SHOT message displayed
		How Sec	Gun READY and SHOT	BCS	Monitor gun ready/firing status	READY indication and FIRE SHOT indication received from How Sec	Self, FDO		Observe READY and FIRE SHOT indication on BCS display	Observe READY and FIRE SHOT indication on BCS
				BCS, Stop Watch	Press XMIT key to transmit FM; FOCMD: SHOT message; start Splash countdown	FM; FOCMD: SHOT message transmitted to FO; FM; FOCMD: SPLASH message displayed; countdown initiated	FO, Self		Shot message transmitted promptly	Observe SHOT message transmitted

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
				BCS, Stop Watch	Observe time of flight 10 seconds to impact; press XMIT key 10 seconds before impact of round to transmit FM; FOCMD: SPLASH message	FM; FOCMD: SPLASH message transmitted to FO; FM; SUBS message displayed with ballistic computations entered in appro-priate fields	FO, FDO		XMIT key pressed 10 seconds before impact	Observe XMIT key pressed correctly
		FO/ FIST	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; SUBS: EOM message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe Alarm and FIRE MSN Lamp off
*This flow assumes no replot desired; covered in SM 061-279-2005				BCS	Review EOM* field	Message reviewed	Self, FDO			
				BCS	Press EXEC key	FM; SUBS mes-sage sent to FSO. Current mission updated to EOM, then deleted. EOM transmitted to How Sec	FSO How Sec		EXEC key pressed promptly and EOM message updated	Observe EXEC key pressed correctly and EOM message updated
		How Sec	Gun ACK	BCS	Observe ACK and displays cleared	Displays cleared	FDO, Self		ACK message received and displays cleared	Observe guns ACK and displays cleared

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/21/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data TACFIRE (Area Mission) **SM Task # & Name** 061-279-2002 061-279-2003 061-279-2004 Determine Firing Data for TACFIRE for a Target Located by Grid Coordinates, Polar Plot, and Shift from a Known Point (Area Mission) TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Chapter 3, Pg. 28) [Advance Copy] *Note: Messages transmitted automatically through TACFIRE to FO/FIST		TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Observe alarm and FIRE MSN Lamp on BCS	Initiation of task	Self	00:00	Message alarm and FIRE MSN Lamp observed	Observe performance
				BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; FC; PRI message displayed	Self		ALARM ACK key and RCVD MSG key are pressed promptly	Observe Alarm off and message displayed
				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; FM; FC; PRI reflects fire order; gun orders automatically computed and displayed on BCS	Self		FM; FC; PRI content correct; EXEC key pressed promptly	Compare fire order content with displayed FM; FC; PRI
				BCS	Press XMIT key to transmit gun orders to How Sec	Gun orders transmitted to How Sec; polling status displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed	Observe polling status
		TAC-FIRE	FM; MTO, FM; FOCMD: SHOT and FM; FOCMD: SPLASH messages*	BCS	Press NEXT SEG key three times	Related messages reviewed	FO/FIST, Self		NEXT SEG key pressed promptly; messages reviewed	Observe related messages
		TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; FC; PRI message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe alarm off and message displayed
				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; FM; FC; PRI message reflects fire order; gun orders automatically computed and displayed on BCS	Self		FM; FC; PRI content correct; EXEC key pressed promptly	Compare fire order content with displayed FM; FC; PRI

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ____ Date: 3/21/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				BCS	Press XMIT key to transmit gun orders to How Sec	Gun orders transmitted to How Sec; polling status displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed	Observe polling status
		TAC-FIRE	FM; MTO, FM; FOCMD: SHOT and FM; FOCMD: SPLASH messages*	BCS	Press NEXT SEG key three times	Related messages reviewed	FO/ FIST, Self		NEXT SEG key pressed promptly; messages reviewed	Observe related messages
*Note: Messages transmitted automatically through TACFIRE to FO/ FIST		TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; FC; PRI message displayed	Self	MSG keys pressed promptly	ALARM ACK and RCVD keys pressed promptly	Observe alarm off and message displayed
				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; FM; FC; PRI message reflects fire order; gun orders automatically computed and displayed on BCS	Self		FM; FC; PRI content correct; EXEC key pressed promptly	Compare fire order content with displayed FM; FC; PRI
				BCS	Press XMIT key to transmit gun orders to How Sec	Gun orders transmitted to How Sec; polling status displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed	Observe polling status
		TAC-FIRE	FM; MTO, FM; FOCMD: SHOT and FM; FOCMD: SPLASH messages*	BCS	Press NEXT SEG key three times	Related messages reviewed	FO/ FIST, Self		NEXT SEG key pressed promptly; messages reviewed	Observe related messages

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [x] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision ___ Date: 3/21/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	Fire For Effect Phase message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe alarm off and message displayed
				BCS	Press EXEC key	Gun orders displayed on BCS	Self		EXEC key pressed promptly	Observe gun orders displayed
				BCS	Press XMIT key to transmit gun orders to How Sec	Gun orders transmitted to How Sec; polling status displayed on BCS	How Sec		XMIT key pressed promptly; polling status displayed	Observe polling status
*Note: Messages transmitted automatically through TACFIRE to FO/FIST		TAC-FIRE	FM; MTO, FM; FOCMD: SHOT and FM; FOCMD: SPLASH messages*	BCS	Press NEXT SEG key three times	Related messages reviewed	FO/FIST, Self		NEXT SEG key pressed promptly; messages reviewed	Observe related messages
		TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; EOM message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe FM; EOM message
				BCS	Review message	Message reviewed	Self		Message reviewed promptly	Observe message
**This flow assumes no Replot desired (See task 061-279-2005)				BCS	Press EXEC key	FM; EOM message transmitted to How Sec; display updated; display cleared**	How Sec, Self		EXEC pressed promptly; display cleared	Observe display cleared

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Replot Data SM Task # & Name 061-279-2005 Replot Targets with the BCS (HE: Q, TI, VT) TRI: 40 References/Notes • TM-11-7440-283-12-1-1 (Chapter 3, Pg. 141) [Advance Copy]	2a) Noise environmental 2b) Noise equipment 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FO/ FIST	EOM: RAT message	BCS	Display related message	FM; SUBS message with EOM: RAT message displayed	Self	00:00	FM; SUBS/EOM: RAT message properly displayed	Observe FM; SUBS/ EOM: RAT message displayed on BCS
				Area Map, Plotting Equipment	Plot target coordinates on area map	Target altitude (in meters) determined	Self		Target coordinates correctly plotted on area map	Observe target coordinates correctly plotted
				BCS	Enter "X" in REP: field and target altitude (meters) in ALT: field	REP: field and ALT: field contain target coordinates	Self		REP: and ALT: fields contain correct target coordinates	Observe target coordinates correctly entered in REP: and ALT: fields
				BCS	Press EXEC key	Related message displayed with new target coordinates automatically recomputed	Self		EXEC key pressed promptly; message displayed with recomputed target coordinates	Observe recomputed target coordinates message displayed
				Area Map, Plotting Equipment	Plot new target coordinates on area map	New target altitude (in meters) is determined	Self		New target coordinates correctly plotted on area map	Observe new target coordinates correctly plotted
				BCS	Compare target altitude computed in #2, above, with target altitude computed in #5, above. Repeat process until comparison is within one-half contour interval	Target altitude comparison is within one-half of a contour interval	Self		Target altitude comparison correctly made to within one-half of a contour interval	Observe target altitude comparison correctly made

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
				BCS	Enter "X" in EOM: field and T or K in RAT: field	EOM: field and RAT: field contain target data	Self		EOM: and RAT: fields contain correct target data	Observe EOM: and RAT: fields contain correct data
				BCS	Press EXEC key	EOM message transmitted to How Sec. FM; SUBS message transmitted to FO/FIST. Displays deleted. Mission entered in file	How Sec FO/ FIST Self		EXEC key pressed promptly; displays deleted	Observe EXEC key pressed and displays deleted

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): SR FD Sp (Computer, BCS Operator)

Prequisites: BCS Initialized; Digital Comm. Established; Order to Conduct Prec Reg

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 12/15/83

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data SM Task # & Name 061-279-2011 Determine Firing Data for Specific Shell-Fuze Combinations using BCS (Comp) TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Chapter 3, Pg. 3-39)	2) Noise--within FDC operation 7) High communication load 9) Personal equipment and clothing including gloves and mask 10) Operational state-target load	FO (FIST)	Msg Alarm lighted and audible	BCS	Observe Msg Alarm on BCS	Initiation of task	Self (Comp)	00:00	Msg Alarm observed	None, until acknowledged
				BCS	Press Alarm Ack once and Msg Revd twice	Displayed PTM stating direction to RP	Self (Comp)		Alarm Ack key and Revd Msg keys are pressed promptly	Observe Alarm Off and Message Displayed. ACK at FO
				Paper, Pencil	Announce message contents and record direction	Announcement of direction	FDO, Ch FS Sp, FD Sp		Message content correctly repeated	Compare announced message content with display of message content
		FDO	Announcement to process registration mission	BCS	Display FM; RFAF from known point file and announce contents	Announcement of known point contents (coordinates, etc.)	FD, Ch FD Sp, FD Sp, Self (Comp)		Message content correctly repeated	Compare announced message content with display of message content
		FDO	Issued Fire Order	BCS	Edit/enter direction and other changes to FM; RFAF as specified in Fire Order	Displayed FM; RFAF message in accordance with Fire Order	Self (Comp), FDO, Ch FD Sp		FM; RFAF message fields edited correctly in accordance with Fire Order	Compare displayed editted FM; RFAF message with requested Fire Order
				BCS	Review message and press EXEC	BCS displays Gun Orders Mission displayed in BCS current mission file. FM; RFAF xmitted to FSO	FSO, FDO, Ch FD Sp Self (Comp)		EXEC is pressed when desired FM; RFAF is correct	Compare displayed Gun Orders with Fire Order. Observe desired weapon, shell-fuze combinations. FM; RFAF message received by FSO
				BCS	Review Gun Orders for completeness/accuracy	Determination that Gun Orders are complete/accurate	Self (Comp), FDO, Ch FD Sp		Gun Orders reflect FDO's Fire Order	Compare displayed Gun Orders to Fire Order Request
										(continued)

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): SR FD Sp (Computer, BCS Operator)

Prequisites: BCS Initialized; Digital Comm. Established; Order to Conduct Prec Reg

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 12/15/83

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				BCS	Press XMIT to transmit Gun Orders to FB	Gun Orders transmitted. Gun polling status and FM; MTO displayed on BCS	FO, FDO, Ch FD Sp, Self (Comp)		Gun Orders transmitted promptly without error	Observation of BCS polling status and displayed FM; MTO
				BCS	Review FM; MTO and press XMIT to transmit FM; MTO when polling status shows *Ready*	FM; MTO transmitted. Gun polling status displayed on BCS	FO, FDO, Ch FD Sp, Self (Comp)		FM; MTO transmitted promptly in accordance with Fire Request	Observation of procedural task steps performed by BCS operator. ACK received from FO

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [x] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Coordinate Battery in Battalion Mass Fire	2a) Noise environmental 2b) Noise equipment 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	TAC-FIRE	Audible alarm on. FIRE MSN Lamp on	BCS	Observe alarm and FIRE MSN Lamp on BCS	Initiation of task	Self		Message alarm and FIRE MSN Lamp observed	Observe performance
				BCS	Press ALARM ACK key once and RCVD MSG key twice	NNFP; FC message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly; NNFP; FC message displayed	Observe alarm off and NNFP; FC message displayed
SM Task # & Name 061-279-2016 Determine/Process Data for a TACFIRE-Specified Time-On-Target Fire Mission TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Chapter 3, Pg. 34) [Advance Copy]				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; NNFP; FC reflects fire order; gun orders automatically computed and displayed on BCS	Self		NNFP; FC content correct; EXEC key pressed promptly	Compare fire order content with displayed NNFP; FC
				BCS	Press XMIT key to transmit gun orders to How Sec	Gun orders transmitted to How Sec; time-to-fire countdown clock displayed; FM; MTO message displayed	How Sec		XMIT key pressed promptly; time-to-fire clock displayed; FM; MTO message displayed	Observe messages displayed on BCS
				BCS	Press FIRE key	Command to fire stored in BCS until countdown clock reaches 000; at 000 command automatically transmitted to How Sec	How Sec		FIRE key pressed promptly	Observe FIRE key pressed promptly
*Note: Messages transmitted automatically through TACFIRE to FO/FIST		TAC-FIRE	FM; M.O, FM; FOCMD: SHOT and FM; FOCMD: SPLASH messages.* Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; EOM message displayed*	Self		ALARM ACK and RCVD keys pressed promptly; FM; EOM message displayed	Observe alarm and FIRE MSN Lamp off and FM; EOM message displayed on BCS

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): Computer (BCS Operator)

Prequisites: BCS Initialized; Digital Comm. Established

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/22/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
**This flow assumes no Replot (see Task 061-279-2015)				BCS	Review message in accordance with SOP and press EXEC key	FM; EOM message reviewed and transmitted to How Sec; display updated; display cleared**	How Sec, Self		Message reviewed and EXEC key pressed promptly; display cleared	Observe message; observe display cleared

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): Computer (BCS Operator)

Prequisites: BCS Initialized; Digital Comm. Established

Task Classification:
[ ] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
Control/Coordinate FPE Mission SM Task # & Name 061-279-2017 Process/Determine Data for a Quick Fire Mission TRI: 74 References/Notes • TM-11-7440-283-12-1-1 (Chapter 3, Pg. 82) [Advance copy]	2a) Noise environmental 2b) Noise equipment 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FO/ FIST	Audible alarm on FIRE MSN lamp on	BCS	Observe alarm and FIRE MSN lamp on	Initiation of task	Self	00:00	Message alarm and FIRE MSN lamp observed	Observe performance
				BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; QF message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe alarm off and message displayed
				BCS	Press EXEC key	Known point number assigned to target; entered in known point file; lower display cleared; file status updated and displayed	BCS Self		EXEC key pressed promptly; lower display clear; file status displayed	Observe updated file status displayed on BCS. Observe elapsed time

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data SM Task # & Name 061-279-2300 Determine Firing Data for Shell Illumination—Coordinated (BCS) TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Chapter 3, Pg. 88) (Advance Copy)	2a) Noise environmental 2b) Noise equipment 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FO/ FIST	Audible Alarm on FIRE MSN lamp on	BCS	Observe Alarm and FIRE MSN lamp on BCS; observe input queue increased by 2	Initiation of task	Self	00:00	Message Alarm and FIRE MSN lamp observed	Observe performance
				BCS	Press ALARM ACK key once	Audible alarm off	Self		ALARM ACK key pressed promptly	Observe alarm off
				BCS	Press RCVD MSG key once	INPUT QUEUE data displayed indicating two FM;RFAF messages received	Self		RCVD MSG key pressed promptly	Observe INPUT QUEUE data
				BCS	Press number "1" key and EXEC key	HE portion of first FM;RFAF in input queue displayed	Self		Number "1" key and EXEC key pressed promptly	Observe FM;RFAF (HE Portion) message displayed on BCS
				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; FM; RFAF transmitted to FO/FIST; gun orders automatically computed and displayed; mission placed in current mission file (HE Portion)	FO/ FIST, BCS, Self		EXEC key pressed promptly, gun orders displayed	Observe gun orders displayed on BCS
				BCS	Press XMIT key	Gun orders transmitted to How Sec; polling status displayed; FM;MTO displayed (HE Portion)	How. Sec, Self		XMIT key pressed promptly; polling status and FM;MTO displayed	Observe polling status and FM;MTO displayed

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
(1)When ACK received, display second FM;RFAF prior to receiving Gun READY		How. Sec.	Gun ACK(1)	BCS	Press XMIT key	DATA/ACK indication received from How. Sec.; FM; MTO transmitted to FO/ FIST; FM; FOCMD:READY message displayed; monitor polling status (HE Portion)	FO/ FIST, Self		XMIT key pressed promptly; FM; FOCMD:READY message displayed	Observe FM; FOCMD: READY message displayed on BCS. Observe Gun ACK indication on display
				BCS	Press RCVD MSG key once, number "1" key and EXEC key	Illumination portion of second FM; RFAF in input queue displayed	Self		RCVD MSG, number "1" and EXEC keys pressed promptly	Observe FM;RFAF (illumination portion) message displayed on BCS
				BCS	Review message in accordance with SOP and press EXEC key	Message reviewed; FM; RFAF transmitted to FSO; gun orders automatically computed and displayed; mission placed in current mission file (Illumination Portion)	FSO, BCS, Self		EXEC key pressed promptly; gun orders displayed	Observe gun orders displayed on BCS
				BCS	Press XMIT key	Gun orders transmitted to How. Sec.; polling status displayed; FM; MTO displayed (Illumination Portion)	How. Sec., Self		XMIT key pressed promptly; polling status and FM; MTO displayed	Observe polling status and FM; MTO displayed

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		How. Sec.	Gun ACK	BCS	Press XMIT key	DATA/ACK indication received from How. Sec.; FM; MTO transmitted to FO/FIST (Illumination Portion); FM; FOCMD:READY message displayed (HE Portion)	Self, FO/FIST		XMIT key pressed promptly; FM; FOCMD: READY message (HE Portion) displayed	Observe FM; FOCMD: READY message displayed on BCS
		How. Sec.	Gun READY and SHOT	BCS	Monitor gun ready/firing status	READY indication and FIRE SHOT indication received from How. Sec. (HE Portion)	Self		Observe READY and FIRE SHOT indication on BCS display (HE Portion)	Observe READY and FIRE SHOT indication on BCS
				BCS Stopwatch	Press XMIT key to transmit FM; FOCMD:SHOT message; start Splash countdown	FM; FOCMD: SHOT message transmitted to FO/FIST; FM; FOCMD:SPLASH message displayed; countdown initiated (HE Portion)	FO/FIST, Self		SHOT message transmitted promptly (HE Portion)	Observe XMIT key pressed promptly and SHOT message transmitted
				BCS Stopwatch	Observe time of flight 10 seconds to impact; press XMIT key 10 seconds before impact of round to transmit FM; FOCMD:SPLASH message	FM; FOCMD: SPLASH message transmitted to FO/FIST (HE Portion)	FO/FIST, Self		XMIT key pressed 10 seconds before impact (HE Portion)	Observe XMIT key pressed correctly
(2)Note: SHOT and SPLASH messages are not required		How. Sec.	Gun READY	BCS	Press XMIT key	READY indication received from How. Sec.; FM; FOCMD: READY message transmitted to FO/FIST (Illumination Portion)(2)	FO/FIST, Self		XMIT key pressed promptly	Observe XMIT key pressed promptly and FM; FOCMD:READY message transmitted

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		FO/ FIST	Audible Alarm on; FIRE MSN Lamp on	BCS	Press ALARM ACK key once	Alarm and FIRE MSN lamp off; gun orders automatically transmitted to How. Sec.; polling status updated	How. Sec., Self		ALARM ACK key pressed promptly	Observe Alarm off
				BCS	Press NEXT SEG key 4 times	FM; RFAF message displayed[3] (Illumination Portion)	Self		NEXT SEG key pressed promptly	Observe FM; RFAF (Illumination Portion) displayed on BCS
[3]Note: FM; MTO, FM; FOCMD: SHOT and FM; FOCMD:SPLASH messages not required		FO/ FIST	Audible Alarm on; FIRE MSN Lamp on	BCS	Press ALARM ACK key once	Alarm and FIRE MSN lamp off; gun orders automatically transmitted to How. Sec.; polling status updated	How. Sec., Self		ALARM ACK key pressed promptly	Observe Alarm off
				BCS	Press NEXT SEG key 4 times	FM; RFAF message displayed; (HE Portion)[4]	Self		NEXT SEG key pressed promptly	Observe FM; RFAF (HE Portion) displayed on BCS
[4]Note: Same as Note 3.		FO/ FIST	Audible Alarm on; FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	Alarm and FIRE MSN lamp off; FM; SUBS message displayed (Illumination Portion)	Self		ALARM ACK and RCVD MSG keys pressed promptly	Alarm and FIRE MSN lamp off; FM; SUBS message displayed
				BCS	Review message in accordance with SOP and press EXEC key	FM; SUBS automatically transmitted to FO/ FIST; current mission (Illumination Portion) updated in file to EOM; EOM transmitted to How. Sec.; display cleared	FO/ FIST, How. Sec., Self		EXEC key pressed promptly; display cleared	Observe display cleared

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/23/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		FO/ FIST	Audible Alarm on; FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	Alarm and FIRE MSN lamp off; FM; SUBS message displayed (HE Portion)	Self		ALARM ACK and RCVD MSG keys pressed promptly	Alarm and FIRE MSN lamp off; FM; SUBS message displayed
				BCS	Review message in accordance with SOP and press EXEC key	FM; SUBS automatically transmitted to FO/ FIST; current mission (HE Portion) updated in file to EOM; EOM transmitted to How. Sec.; display cleared	FO/ FIST, How. Sec., Self		EXEC key pressed promptly; display cleared	Observe display cleared

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): FD Sp (Chart Operator)
Prequisites: Prepared Firing Chart
Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 12/28/83
Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data SM Task # & Name 061-280-1001 Plot Targets, Determine and Announce Chart Data (and Angle T) TRI: 89 References/Notes • FM 6-40 (Chapter 3, Section III) • SM(FM6-13E)	2a) Noise—environment 8) Workspace restriction (FDC-vehicle) 9) Personal equipment, e.g., gloves, helmet, mask 10) Operational state, e.g., target load	FDO	Request to plot known point and determination of chart range	Known point data	Hear request to plot known point and determine chart range	Initiation of task	Self (FD Sp)	00:00	Chart data. Task is initiated promptly	None until next task element
				Firing Chart, Plotting Scale (Aluminum), Plotting Pin	Using plotting scale (aluminum) and plotting pin, plot known point coordinates and tick mark and RP designation	Plotted and designated. RP on firing chart	Self (FD Sp), Ch FD Sp, FDO		RP accurately plotted and identified within ± 30 meters (SM)	Plot to verify accuracy
				Firing Chart, Plotting Pin, RDP	Using RDP, battery center, plotting pin, determine chart range to RP	Chart range to RP	Self (FD Sp), Ch FD Sp, FDO		Chart range accurately measured within ± 30 meters (SM)	Verify by measuring chart range
				None	Announce chart range	Chart range announced	FDO, Ch FD Sp		Chart range correctly announced (FM)	Compare announced chart range to determined chart range

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): FDO/Ch FD Sp

Prequisites: Commander's Guidance; Knowledge of Enemy Firing Detection Capabilities

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 12/27/83

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Coordinate/Control Fire Missions SM Task # & Name 061-280-3000 Use FDC Procedures which Deceive the Enemy as to the Existence and Location of the Firing Batteries (FDO, Ch FD Sp) TRI: 89 References/Notes • FM6-40 (Chapter 5, Sec. I) • SM (FM6-13E) Note: *High charge reduces probability of detection by cb radars but enhances detection by flash, sound and IR detection. To maximize survivability, a lower charge should be selected for firing.	1a) Restricted visibility due to environmental conditions, e.g., darkness, smoke, fog, etc. 2) Noise within the FDC 7) High communications load (digital/voice) 9) Personal equipment (e.g., gloves, mask, helmet) 10) Operational state, enemy ability to detect weapon's fire, etc., overall tactical situation, e.g., type of mission support, enemy action	Bn FDC or self (FDO). List/chart of plotted known points	Request/decision to conduct precision registration	Chart with known points plotted	Consider commander's guidance. Review firing chart and select a suitable known point as the RP	Initial selection of a known point to conduct registration firing	Ch FD Sp Self (FDO)	00:00	Select a known point which is suitable and, to extent possible, minimizes detection by enemy target location agencies (FM)	Compare selection of RP to those available for determination of suitability and likelihood of detection by enemy target location agencies
				None	Request chart range to select RP	Verbal request for chart range from Battery Center to RP	FD Sp		Request is clearly understood. Requires no interpretation	Observe subsequent action by FD Sp determining chart range to RP
		FD Sp	Announcement of chart range to RP	RDP GFT fan	Observe target plotted and various charges that can be used to reach RP	Knowledge of available charges that will reach RP	Self (FO/ Ch FD Sp)		Correct assessment of available charges to reach RP (FM)	Compare FDO/Ch FD Sp assessment of available charges to observers' assessment
		Cmdr	Commander's Guidance with regard to use of ammunition and knowledge of enemy capabilities to detect the firing unit's location	None	Consider commander's guidance and enemy's detection capability and determine firing charge to RP	Selection of charge to RP. Retain charge knowledge as an element of the Fire Order	Self (FO/ Ch FD Sp)		Correct charge is selected based on Commander's Guidance and knowledge of enemy's detection capabilities*	
		SOP	Communication security procedures	SOP	Assure that communication security procedures are rigidly followed per SOP	Secure communication procedures in accordance with SOP's	All comm. equipment operators in FDC digital, voice, wire nets		Communication procedures are rigidly followed by all radio and telephone operators on FDC radio (digital/voice) and wire nets (SM)	Monitor communications for violation of communication procedures
										(continued)

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): FDO/Ch FD Sp

Prequisites: Commander's Guidance; Knowledge of Enemy Firing Detection Capabilities

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 12/27/83

Analyst: J. Hamilton

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
								Variable	Registration should be accomplished only when absolutely necessary (SM)	Assessment of the need to register and selected registration technique

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC
Section Position(s): Computer (BCS Operator)
Prequisites: BCS Initialized; Digital Comm. Established
Task Classification: [ ] Procedural (Fixed, Structured) [X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/26/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Determine Firing Data **SM Task # & Name (No SM #)** Determine Firing Data for a Target of Opportunity - Copperhead TRI: 74 References/Notes • TM11-7440-283-12-1-1 (Chapter 3, Pg. 125) [Advance Copy] *Note: FO/FIST transmits FM; FOCMD: FIRE to How Sec	1a) Visibility environmental 1b) Visibility equipment 3) Moving vehicle 4) Temperature and/or humidity extremes 5) Weather 6) Terrain 7) High communication load 9) Personal equipment and/or clothing 10) Operational state	FO/ FIST	Audible alarm on. FIRE MSN Lamp on	BCS	Observe alarm and FIRE MSN Lamp on	Initiation of task	Self	00:00	Message alarm and FIRE MSN Lamp observed	Observe performance
				BCS	Press ALARM ACK key once and RCVD MSG key twice	FM; RFAF message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe FM; RFAF message displayed on BCS
				BCS	Review message in accordance with SOP and press EXEC key	FM; RFAF automatically transmitted to FSO; gun orders automatically computed and displayed; mission placed in current mission file	FSO Self		EXEC key pressed promptly	Observe gun orders displayed on BCS
				BCS	Press XMIT key	Gun orders transmitted to How Sec; polling status displayed; FM; MTO message displayed	How Sec		XMIT key pressed promptly	Observe polling status displayed
		How Sec	Gun ACK	BCS	Monitor gun polling status	DATA/ACK indication received from How Sec	Self		Observe ACK indication on BCS display	Observe ACK indication on display
				BCS	Press XMIT key	FM; MTO transmitted to FO/ FIST; FM; FOCMD: READY message displayed	FO/ FIST Self		XMIT key pressed promptly	Observe FM; FOCMD: READY message displayed
		How Sec	Gun READY	BCS	Monitor gun polling status	READY indication received from How Sec	Self		Observe READY indication on BCS display	Observe READY indication on display
				BCS	Press XMIT key	FM; FOCMD: READY message transmitted to FO/FIST*	FO/ FIST		XMIT key pressed promptly	Observe READY message transmitted to FO/FIST

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: FDC

Section Position(s): Computer (BCS Operator)

Prequisites: BCS Initialized; Digital Comm. Established

Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/26/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
		FO/ FIST	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once	Alarm and Lamp off; polling status indicates first gun fired	Self		ALARM ACK key pressed promptly; observe first gun fired on BCS display	Observe polling status—first gun fired—on BCS display
				BCS	Press XMIT key	First FM; FOCMD: SHOT message transmitted to FO/ FIST	FO/ FIST		XMIT key pressed promptly	Observe FM, FOCMD: SHOT message transmitted
				BCS	Press PREV SEG key	Second FM; FOCMD: SHOT message displayed	Self		PREV SEG key pressed promptly	Observe second FM; FOCMD: SHOT message displayed on BCS
		How Sec	Gun SHOT	BCS	Monitor gun polling status	SHOT indication received from How Sec	Self		SHOT indication on BCS	Observe SHOT indication on BCS display
				BCS	Press XMIT key	Second FM; FOCMD: SHOT message transmitted to FO/ FIST	FO/ FIST		XMIT key pressed promptly	Observe FM; FOCMD: SHOT message transmitted
		FO/ FIST	Audible alarm on. FIRE MSN Lamp on	BCS	Press ALARM ACK key once and RCVD MSG key twice	Alarm and Lamp off; FM; SUBS EOM message displayed	Self		ALARM ACK and RCVD MSG keys pressed promptly	Observe FM; SUBS EOM message displayed on BCS
				BCS	Review message in accordance with SOP and press EXEC key	EOM transmitted to How Sec; display cleared; current mission updated to EOM and deleted; FM; SUBS transmitted to FSO	How Sec, Self, FO/ FIST		EXEC key pressed promptly; display cleared	Observe BCS display cleared. Observe elapsed time

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): Cannoneers (C2,3,4,HD)

Prequisites: Sep Load Ammo Available; Fuze Wrencher, Setters Provided; Night Lite Device Provided; Sec Hand Tools Available

Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 11/28/83

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Prepare Ammo for Firing (C2,3,4,HD) SM Task # & Name 061-266-1506 Prepare Separate-Loading Ammunition for Firing (C2,3,4,HD) TRI: 61 References/Notes: • TM9-2350-303-10 (Chapters 2 & 4) • SM (FM6-13B) 1) All ammunition preparation accomplished outside howitzer 2) Shell, fuze and charge preparation actions are not necessarily performed sequentially	1a) Visibility due to darkness 5) Weather (snow, rain, sleet) 6) Terrain (desert, jungle, etc.) 8) Work space restriction 9) Personal equipment and/or clothing including gloves and mask	Ch Sec	Fire commands--announced shell (1,2)	None	Hear announced fire command	Initiation of task	C3	00:00	Preparation of ammunition task is initiated promptly	Observe performance
				None	C3 Repeat shell/rounds	Repeated shell/rounds	C3,(Self) Ch Sec		Shell correctly repeated (SM/TM)	Compare repeated shell to announced shell
				Shell	Select shell according to color codes and markings stenciled on shell and containers	Shell selected according to announced shell	C3 (Self)		Color codes and markings on shell selected correctly (SM)	Compare selected shell to announced shell
				Shell	Remove any sand, dirt, oil or grease on shell and inspect for damage and corrosion	Cleaned/undamaged shell	C3 (Self)		Shell is free of any foreign matter and is not damaged or corroded (TM)	Visually inspect shell for cleanliness
				Shell Grommet Rotating band	Remove grommet and examine rotating band to ensure it is free of dirt and burrs (3)	Cleaned rotating band	C3 (Self)		Rotating band properly inspected and cleaned (TM)	Visually inspect to ensure rotating band is free of dirt and burrs
				Shell	Visually verify entire shell is free of foreign matter/defects and hold shell upright for fuzing	Shell inspected and held upright for fuzing	C3 (Self)		Shell properly inspected and ready for fuzing (TM)	Observe shell ready for fuzing
		Ch Sec	Fire commands--announced charge (1,2)	None	C4 Repeat announced charge	Repeated charge	C4, (Self), HD, Ch Sec		Charge correctly repeated (SM/TM)	Compare repeated charge to announced charge
				Propellant Charge	Select charge according to announced fire command	Charge selected according to announced charge	C4,HD (Self)		Charge selected correctly compares to charge announced (TM)	Compare selected charge to announced charge

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Section Position(s): Cannoneers (C2,3,4,HD)
Prequisites: Sep Load Ammo Available; Fuze Wrencher, Setters Provided; Night Lite Device Provided; Sec Hand Tools Available
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 11/28/83
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Propellant Charge	Remove charge from metal container and inspect for torn cloth, loose powder grains and/or discoloration and indication that charge is fresh (4)	Charge unpacked, inspected and serviceable	C4, HD (Self)		Charge correctly unpacked and inspected (TM)	Visually inspect charge is free of tears, dirt, etc.
				Propellant Charge Igniter pad	Inspect/examine igniter pad for tears or wetness (powder grains should move freely inside the pad) (4)	Igniter pad inspected/examined and serviceable	C4, HD (Self)		Igniter pad correctly inspected and free of tears and wetness (TM)	Visually inspected igniter pad (free of defects)
				Propellant Charge	Untie tie straps and remove excess powder increments according to announced charge and retie and secure straps	Charge prepared according to announced charge	C4, HD (Self)		Charge properly prepared in accordance with announced charge (TM)	Compare prepared charge to announced charge
				Unused powder increments	Set aside unused powder increments in secure area (5)	Unused powder increments secured	C4, HD (Self)		Unused powder increments placed in secure area (TM)	Visually inspect unused powder increments secure
				Propellant Charge Igniter pad	Protect igniter pad from wetness or damage until loaded	Protected igniter pad	C4,HD (Self)		Igniter pad free of wetness or damage (TM)	Visually inspected igniter pad free of wetness or damage
				Propellant Charge	C4 Pass/hand prepared propelling charge to C1	Propelling charge properly handed to C1	C1		Properly hand propelling charge, prepared according to fire command, to C1 (TM)	Compare prepared charge to announced charge

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): Cannoneers (C2,3,4,HD)

Prequisites: Sep Load Ammo Available; Fuze Wrencher, Setters Provided; Night Lite Device Provided; Sec Hand Tools Available

Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 11/28/83

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		Ch Sec	Fire commands—announced fuze (1,2)	None	C2 Repeat announced fuze	Repeated fuze	C2,(Self) Ch Sec		Fuze correctly repeated	Compare repeated fuze to announced fuze
				Eyebolt lifting plug Gasket	Remove eyebolt lifting plug and gasket and examine fuze well/socket for damage, rust, dirt and high-explosive residue (6)	Fuze well/socket inspected and free of damage and/or foreign material	C2 (Self)		Fuze well/socket inspected and serviceable	Visually inspect fuze well/socket free of damage, rust, dirt or high explosive material
				Fuze	Select fuze according to fire command	Fuze selected according to announced fuze	C2 (Self)		Fuze selected correctly compares to announced fuze (TM)	Compare selected fuze to announced fuze
				Fuze VT Lifting loop	Remove supplementary charge, if required by lifting loop (7)	Supplementary charge removed, if required	C2 (Self)		Supplementary charge removed, if required (TM)	Compare announced fuze to prepared fuze
				Fuze	Screw fuze into shell by hand and then back off 1/4 turn	Fuze ready to be seated on shell	C2 (Self)		Fuze properly prepared for seating (TM)	Visually observe fuze ready for seating
				Fuze Fuze Setter Wrench	Using appropriate fuze setter wrench, tighten fuze so that fuze shoulder is seated firmly against shell	Fuze seated in shell	C2 (Self)		Fuze shoulder seated against shell without gap (TM)	Visually observe fuze seated without gap
				Fuze Setter Wrench, Fuzed Shell	(Fuze Q or Delay) Using appropriate fuze setter wrench, turn slot to align with desired fuze action, if required	Fuze set to desired fuze action	C2 (Self)		Fuze action set in accordance with Fire Command (SM)	Compare announced fuze action to prepared fuze action

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): Cannoneers (C2,3,4,HD)

Prequisites: Sep Load Ammo Available; Fuze Wrencher, Setters Provided; Night Lite Device Provided; Sec Hand Tools Available

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 11/28/83

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Fuzed Shell Fuze Setter Wrench	(Fuze Time) Remove safety wire from fuze and, using appropriate fuze setter wrench, set announced time	Fuze set to desired time setting	C2 (Self)		Desired time set without error to the nearest .01 sec (SM)	Compare announced fuze setting to prepared fuze setting
				Fuzed Shell	C2 Pass fuzed shell to C1	Fuzed shell handed to C1	C1		Properly inspected and fuzed shell handed to C1 (TM)	Compare prepared/ fuzed shell to announced shell

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section

Section Position(s): Gunner (G)

Prequisites: Howitzer Laid; Collimator Emplaced; Boresighting Completed; Pre-fire Checks Performed

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 3 Date: 11/30/83

Analyst: J. Hamilton/R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Lay Howitzer for Direction and Quadrant (G, AG, Ch Sec) SM Task # & Name 061-266-2229 Set/Lay the Howitzer for Deflection (G) TRI: 61 References/Notes • TM9-2350-303-10 (Chapter 2, Pg. 2-151) • SM (FM6-13B) Note: *Announcement of "Set" can occur any time prior to Gunner centering bubbles	1a) Visibility due to darkness 1b) Visibility due to Pantel 5) Weather (snow, rain, sleet) 9) Personal equipment and clothing incl. gloves and mask	Ch Sec	Announcement of deflection	GDU	Hear announced deflection See displayed deflection	Initiation of task	Self (G)	00:00	Deflection task is initiated promptly (SM)	Observe performance
		GDU	Displayed deflection							
				None	Repeat announced/displayed deflection	Repeated deflection	Ch Sec		Deflection is correctly repeated (SM)	Compare repeated deflection to announced/displayed deflection
				Pantel	Rotate azimuth knob to required deflection	Indication of set deflection	Self (G)		Deflection is correct on reset counter (SM)	Compare reset counter to announced/displayed deflection
				Pantel, Collimator, Traversing Control(s)	Traverse howitzer until collimator is sighted through Pantel	Indication of aligned reticles (Pantel and Collimator)	Self (G)		Pantel and Tube and Collimator are aligned to within 0 mils (SM)	Compare to Pantel reticle (and Tube) to Collimator reticle
		AG	Announcement of elevation "Set"*	None	Hear announced "Set"	Continuation of task to completion	Self (G)		"Set" is heard correctly (TM)	None
				Pantel mount	Center pitch and cross-level vial bubbles on the Pantel mount	Indications of centered bubbles	Self (G)		Bubbles are centered (SM)	Compare bubble positions to centering marks
				Pantel, Collimator, Traversing Control(s)	Verify or adjust deflection on reset counter, centering of bubbles and Pantel-Collimator sight picture	Indications of: • Set deflection • Bubbles centered • Aligned Pantel-Collimator sight picture	Self (G)		Deflection is correct on reset counter. Bubbles are centered. Pantel and Collimator are aligned to within 0 mils (TM)	Compare Pantel reticle (and Tube) to Collimator reticle. Compare bubble positions to centering marks
				None	Announce "Ready"	Announcement of deflection "Ready"	Ch Sec		"Ready" is correctly announced at proper time (SM)	Hear "Ready" announcement after "Set" announcement
								00:15 Total	Deflection is accurate to within 0 mils (SM)	Measure time for total task of laying howitzer to proper deflection

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Safety T Completed for Each Charge; Howitzer Laid; Digital Comm. Estab'd w/FDC
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 11/23/83
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs: From	Inputs: Content	Process: Equipment	Process: Actions	Outputs: Content	Outputs: To	Time (min:sec)	Performance Standard(s)	Present Assessment Method
Process Fire Commands **Lay Howitzer for Direction and Quadrant** **Load Howitzer** **Fire Howitzer** SM Task # & Name 061-266-3315 Determine that the Howitzer is Safe to Fire (Ch Sec) TRI: 61 References/Notes • FM6-50 (25 Mar 83) • TC6-1-2 (May 83) • TM11-7440-283-12-2 Related task of "Operate GDU/SCA" analyzed separately.	1a) Visibility, environmental 5) Weather 9) Personal equipment and clothing	FDC	Displayed Fire Command: Audible alarm and message header	GDU (SCA)	Receive audible alarm and visual signals	Initiation of Fire Command	Self (Ch Sec)		Audible alarm and visual signals observed promptly (TM, TC)	Observe performance
					Announce "Fire Mission," number of gun, number of mission, type of mission control	Announcement of fire mission, number of gun, number of mission, type of mission control	G AG C		Announcement made accurately and in correct format (TM, FM)	Compare announcement with data and format guidelines
				SCA	Press CYCLE key	Acknowledgment signal	FDC		Key is pressed promptly (TM, TC)	Observe performance
				SCA	Observe ACK in display window	Decision that ACK was sent	Self (Ch Sec)		ACK is observed properly by Ch Sec (TM)	Ch Sec proceeds to next appropriate step
		FDC	Fire mission data (stored in SCA)	SCA	Cycle through Fire Mission Commands	(see below)			(see below)	(see below)
				SCA	Press CYCLE or other SCA keys to display data	Display of next or requested fire mission message element	Self (Ch Sec)		CYCLE key is pressed without delay	Observe promptness of cycling
				SCA	Read/announce data from Command bar and sequential display window: • Type of mission • Type of mission control • Special instructions • Shell • Lot • Rounds • Charge • Fuze • Deflection • Time • Q elevation	Announcement of next or requested fire mission message element or command	G AG C		Message element is correctly announced (FM). (Later) Message element is correctly repeated (see next IPO items)	Compare displayed with announced message element

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Safety T Completed for Each Charge; Howitzer Laid; Digital Comm. Estab'd w/FDC
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 11/23/83
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		G, AG, C	Repeated commands		Hear repeated commands	Decision that commands were heard	Self (Ch Sec)		Commands are correctly repeated (FM)	Compare announced with repeated commands
		G, AG, C	Request repeat of commands		Hear requests for repeating commands	Decision to repeat commands	Self (Ch Sec)		Repeat requests are correctly heard (FM)	None, until command is repeated
				SCA	Repeat commands as needed	Repeated command	G, AG, C		Command is repeated correctly (FM)	Compare displayed with announced command
				SCA and Safety T	Compare data to Safety T • Determine if data are safe	Decision that data are/are not outside limits	Self (Ch Sec)		Safety of data is correctly determined (FM)	Compare safety determination with Safety T information
					• If data are outside limits, announce "Unsafe to Fire" and give reasons	Announcement of "Unsafe to Fire" with reasons	G, AG, C		Announcement of "Unsafe to Fire" is correctly made (FM)	Compare announcement with prescribed format
					• Take corrective action	As needed	As needed		As specified in governing documentation	As appropriate
					• Report unsafe conditions	Report of unsafe conditions	FDC		Unsafe conditions are reported correctly (FM)	Compare report of unsafe conditions with prescribed format
		Self (Ch Sec) SCA	Fire mission data		Observe that weapon and ammunition are safe	(See below)			(See below)	(See below)
		AG	Quadrant "Set"		• Hear "Set"	Decision that QE is set	Self (Ch Sec)		"Set" is correctly heard (FM)	None, until next events occur
		G	Deflection "Ready"		• Hear "Ready"	Decision that deflection is ready	Self (Ch Sec)		"Ready" is correctly heard (FM)	"Ready" heard after "Set"
		Equipment	Actual shell, fuze, charge		• Compare observed weapon settings, shell, fuze and charge to data	Decision that settings do/do not conform to data	Self (Ch Sec)		Decisions (that settings do/do not conform) are correctly made (FM)	Compare decisions with data and actual equipment settings

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Safety T Completed for Each Charge; Howitzer Laid; Digital Comm. Estab'd w/FDC
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 11/23/83
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Gun	• Insure no obstructions to front of weapon or in recoil path	Decision that obstructions are/are not in way of gun	Self (Ch Sec)		Decisions (that obstructions are/are not in way of gun) are correctly made (FM)	Compare decisions with observed area around gun
				Gun, Shell, Fuze, Charge	• Observe safe loading of weapon	Decision that gun is/is not loaded safely	Self (Ch Sec)		Decision (that gun is/is not loaded safely) is correctly made (FM)	Compare decision with crew's adherence to prescribed data and procedures
		Self (Ch Sec)	Unsafe condition or command to check fire (CHECK FR)	SCA	• If unsafe condition, command "Check Fire"	Announcement of "Check Fire"	G, AG		Announcement is made promptly and clearly (FM)	Announcement heard and acted upon by crew
					• If unsafe, take corrective action, as appropriate	As appropriate	As appropriate		Corrective action is taken promptly and safely (FM)	Compare corrective action with prescribed procedures; FDC notified if necessary
				SCA	• If safe, and if AMC, press READY	READY message	FDC		READY message is received by FDC (TM, TC)	Compare sent with received READY message
					Fire gun; • If WR, announce "Gun No."; "Fire"	Announcement of "Gun No."; "Fire"	G		Announcement to fire is made properly (FM)	Compare announcement with prescribed procedures; (Later) Observe fire
		FDC	If AMC, command to fire (FIRE)	SCA	• If AMC, receive alarm and the command to FIRE; send acknowledgment	Acknowledge (ACK) message	FDC		Audible and visual signals observed promptly (TM, TC)	Compare sending of message and ACK at FDC
					• Announce "Stand By" (AMC)	Announcement of "Stand By"	Crew		Announcement made clearly and promptly (FM, TM)	Observe crew in standby positions
					• Continue observing that weapon is safe (AMC)	Decision that weapon is safe or not safe	Self (Ch Sec)		Safety is correctly observed; hazards correctly and promptly acted upon (FM)	Hazards acted upon in accordance with prescribed procedures

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Safety T Completed for Each Charge; Howitzer Laid; Digital Comm. Estab'd w/FDC
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)
Revision 0 Date: 11/23/83
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
					• If safe, announce "Fire" (AMC)	Announcement of "Fire"	C1 Crew		Announcement made clearly and promptly (FM, TM, TC)	Observe C1 firing weapon upon "Fire" command
		Gun	Firing of gun	Gun	Observe fire; • If malfunction, announce	Announcement of "Misfire" or other malfunction	G, AG, C FDC		Announcement made clearly and promptly (FM)	Compare time of announcement with time of occurrence
				As needed	• Take corrective action for malfunction	Corrective action as needed	As needed		Corrective action is taken promptly and safely (FM)	Compare corrective action with prescribed procedures
				SCA	• If proper fire, press SHOT/RC after each round is fired	SHOT/RC message	FDC		SHOT/RC message is correctly received (TM, TC)	Compare time of fire with receipt of message at FDC
				SCA	• Successively press CYCLE or other SCA keys and announce as needed	Message elements	Self (Ch Sec)		Desired message element is correctly acquired and announced (TM, TC)	Compare desired with acquired and announced messages for accuracy and consistency
				SCA	• Press SHOT/RC one extra time after final round is fired	SHOT/RC message, twice (final round)	FDC		SHOT/RC message is correctly and promptly received at FDC (TM, TC)	Compare fire time of final round with receipt of message at FDC
				Gun	Observe that post-fire procedures (e.g., bore clear) are accomplished • If not clear, take corrective action	Initiation of corrective action, as needed	G, AG, C		Post-fire procedures are taken promptly, correctly and as needed (FM)	Compare actions taken with prescribed procedures

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section (Ch Sec)
Prequisites: Howitzer Laid; Digital Comm. Estab'd w/FDC; Command to Use Gunner's Quadrant
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 12/13/83
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Lay Howitzer for Direction and Quadrant (Ch Sec, G, AG) SM Task # & Name 061-266-3318 Set/Lay for Quadrant with the Gunner's Quadrant (Ch Sec) TRI: 50 References/Notes • SM (FM6-13B) • TM9-2350-303-10 (Chapter 2)	9) Personal equipment and clothing	FDC	Fire Command, including GQ (use Gunner's Quadrant) and quadrant elevation	GDU (SCA)	Receive GQ as special instruction while cycling through Fire Mission Commands	Decision to initiate use of Gunner's Quadrant to set elevation	Self (Ch Sec)	00:00	GQ command is received promptly and accurately	Observe performance
				SCA	Announce use of Gunner's Quadrant and remainder of Fire Mission Command, including quadrant	Announcement of Gunner's Quadrant and remaining commands	G AG C		GQ and other Fire Mission Commands are announced promptly and accurately	Compare announced with SCA-displayed commands
				Gunner's Quadrant (GQ)	Set the announced quadrant on the Gunner's Quadrant	Completed setting of Gunner's Quadrant	Self (Ch Sec)		Quadrant elevation is set to an accuracy of 0 mils on the Gunner's Quadrant (SM)	Compare setting on Gunner's Quadrant with announced quadrant elevation
				GQ Gun	Place the Gunner's Quadrant on the howitzer's quadrant seats	Completed positioning of Gunner's Quadrant	Self (Ch Sec)		Gunner's Quadrant is oriented correctly and placed firmly on the howitzer's quadrant seats (TM)	Compare positioning of Gunner's Quadrant with prescribed positioning
		AG	Activity of the Gunner's Quadrant bubble	GQ Gun	Observe that the AG is operating the elevation controls to level the bubble	Completed leveling of the Gunner's Quadrant bubble	Self (Ch Sec)		AG adjusts gun so that bubble is centered between leveling marks (SM)	Observe that GQ bubble is centered between leveling marks
		AG	Announced quadrant elevation "Set"	GQ Gun	Remove Gunner's Quadrant from the gun's quadrant seats and return to stowed location	Decision that quadrant elevation is set	Self (Ch Sec)		GQ is removed and stowed upon determination that correct quadrant is set	Observe that setting of quadrant is complete
								00:30 (SM)	Lay for quadrant to an accuracy of 0 mils (SM)	Compare GQ setting with announced quadrant, and observe centering of bubble

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Section Position(s): Ch Sec/C1
Prequisites: Misfire Has Occurred
Task Classification:
[ ] Procedural (Fixed, Structured)
[X] Variable (Cognitive, Semi-Structured)

Revision ____ Date: ____
Analyst: ____

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Fire the Howitzer SM Task # & Name 061-266-3322 Take Immediate Action for Misfire TRI: — References/Notes • FM6-13B (Pg. 5-22) • TM9-2350-303-10 (Chapter 2) *Two attempts are made to refire. If both misfire, proceed to next line. **If not fired, replace primer and/or firing mechanism and attempt to fire	1a) Visibility (darkness) 8) Work-space restrictions 9) Personal equipment	Ch Sec	Announce "Misfire." Command "Refire."	Lanyard	Attempt to Refire*	Howitzer Fired	C1		Attempt to Refire initiated promptly	Observe performance
		Ch Sec	Announce third "Misfire"		Determine if tube cold	Tube is cold. (Go to Ⓐ .) (If hot, go to Ⓑ, below.)	C1		Accurate determination tube temperature (non-quantitative)	Observe performance
	Ⓐ	C1	Cold tube		Wait for two minutes	End of two minutes	C1		Timing accuracy	Observe
		Ch Sec, C1	End of waiting period	Primer Chamber	Remove primer	Primer out of chamber	Self, C1		Observe correct safety procedures	Observe
		Ch Sec, C1	Primer out of chamber	Primer	Examine primer	Primer fired	Self, C1		Correctly identified primer condition	Observe
		Ch Sec	Primer Fired**		Wait for 8 minutes	End of 8 minutes	Self			
		Ch Sec C1	End of waiting period		Remove and stow charge. Unload Howitzer	Howitzer cleared	Self, C1		Observed correct safety procedures	Observe
	Ⓑ	C1	Hot tube		Wait for two minutes	End of two minutes	Self		Timing accuracy	Observe
		Ch Sec, C1	End of waiting period	Primer Chamber	Remove primer	Primer out of chamber	Self, C1		Observed correct safety procedures	Observe
		Ch Sec	Primer out of chamber	Primer	Examine primer	Primer fired	Self, C1		Correctly identify primer condition	Observe
		Ch Sec	Primer Fired**		Evacuate crew/ request Ordnance assistance	All crew evacuated. Assistance requested	Self, Ord. Unit		Speed of evacuation	Observe

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Section Position(s): Assistant Gunner
Prequisites: Howitzer Laid; Boresighting Completed; Pre-fire Checks Performed; Communication Established
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 12/1/83
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Lay Howitzer for Direction and Quadrant (AG, G, Ch Sec) SM Task # & Name 061-270-1215 (AG)	9) Personal equipment and/or clothing, including gloves and mask	FDC	Fire Command, including quadrant elevation	GDU (SCA)	Receive Fire Mission Commands (Ch Sec)	Decision to announce Fire Mission (Ch Sec)	Self (Ch Sec)		Fire command is received promptly and accurately	Observe performance
				SCA	Announce Fire Mission Command, including quadrant (Ch Sec)	Announcement of quadrant and remaining commands (Ch Sec)	G AG C	00:00	Fire Mission Commands are announced promptly and accurately	Compare announced with SCA-displayed commands
Set/Lay the Howitzer for Quadrant with the Range Quadrant TRI: 50		Ch Sec GDU	Fire Commands—announced quadrant Displayed quadrant	GDU	Hear announced quadrant See displayed quadrant	Initiation of task	Self (AG)		Quadrant task is initiated promptly	None, until repeated (See below)
References/Notes • TM9-2350-217-10 (Pg. 2-155) • SM (FM-6-13B) Note: *Gunner's actions (traversing) are independent. Therefore, completion of the traversing action can occur at any time while the Assistant Gunner is completing this task.				None	Repeat announced/displayed quadrant	Repeated quadrant	Ch Sec		Deflection is correctly repeated (SM)	Compare repeated quadrant to announced/displayed quadrant
				Elevation quadrant control knob Elevation counter	Rotate elevation quadrant control knob until announced quadrant appears on elevation counter	Indication of announced quadrant appears on elevation counter	Self (AG)		Quadrant is correct on elevation counter (SM)	Compare elevation counter to announced/displayed quadrant
				Cross level knob Cross level vial Quadrant mount	Turn cross level knob until cross level vial bubble centered on quadrant mount	Indication of cross level vial bubble centered on quadrant mount	Self (AG)		Bubble is centered (SM)	Compare bubble position to centering marks

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): Assistant Gunner

Prequisites: Howitzer Laid
Boresighting Completed
Pre-fire Checks Performed
Communication Established

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 2 Date: 12/1/83

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Elevation control handle Elevation level vial	Operate elevation control handle until elevation vial bubble centered	Indication of elevation level vial bubble centered	Self (AG)		Bubble is centered (SM)	Compare bubble position to centering marks
		Gunner	Howitzer traversing action has stopped.*	None	Aware that traversing action has stopped	Indication of traversing action stopped	Self (AG)		Traversing action stopped (TM)	Observe traversing action stopped
				Cross level and elevation level vial bubbles	Verify cross level and elevation level bubbles centered	Indication of cross level and elevation level bubbles centered	Self (AG)		Bubbles centered (TM)	Compare bubble positions to centering marks
				Elevation counter	Verify announced quadrant appears on elevation counter	Indication of announced quadrant on elevation counter	Self (AG)		Quadrant is correct on elevation counter (TM)	Compare elevation counter to announced quadrant
				None	Announce "Set"	Announcement of quadrant "Set"	Gunner and Ch Sec	00:30	"Set" heard correctly (SM and TM)	Measure time for total task of laying howitzer to proper quadrant

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Section Position(s): C1
Prequisites: Fire Command; Howitzer in Firing Position, Tube at Loading Elev., Breech Open; Prepared Round
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 2/8/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Load Howitzer SM Task # & Name 061-270-1507 C1 Load and Fire a Prepared Round (M109 Series) TRI: 61 References/Notes • FM6-13B (Pg. 6-12) • TM9-2350-303-10 (Chapter 2) This analysis covers loading only.	4) Temperature/humidity extremes 5) Extreme weather (snow, rain, sleet) 9) Personal equipment and/or clothing	Ch Sec	Fire commands--announced shell, charge and fuze	None	Hear announced fire command	Initiation of task	C1	00:00	Loading task is initiated promptly	Observe performance
				Rammer Main Release Handle Pointer	Pull rammer main release handle and slide rammer back to rear stop; check pointer is in red band	Rammer located at rear stop and pointer in red band	C1 (Self)		Rammer positioned correctly to rear stop and pointer in red band (TM & SM)	Visually observe rammer at rear stop; pointer correctly returned to red band
				Cylinder Release Handle Main Release Handle Pointer	Grip cylinder release handle with left hand and main release handle with right hand and swing rammer up and forward until latched; check pointer is in black band	Rammer forward and latched and pointer in black band	C1 (Self)		Rammer correctly swung up and forward and properly latched; pointer correctly returned to black band (TM & SM)	Observe rammer up and forward and properly latched; pointer correctly returned to black band
				Cylinder Release Handle	Pull cylinder release handle to unlatch and rotate cylinder to the side	Cylinder in unlatched position and rotated to the side	C1 (Self)		Cylinder correctly in unlatched position and rotated to the side (TM & SM)	Visually observe cylinder unlatched position and rotated to the side
		C3	Projectile received	Projectile Rammer Tray	Place projectile on rammer tray and slide projectile forward until the rear of the projectile is just beyond the line on rammer tray	Projectile placed in correct position on rammer tray	C1 (Self)		Projectile positioned correctly on rammer tray (TM & SM)	Observe rear of projectile correctly positioned just beyond line on rammer tray

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): C1

Prequisites: Fire Command
Howitzer in Firing Position, Tube at Loading Elev., Breech Open
Prepared Round

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 2/8/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		AG	Announced quadrant	Cylinder Release Handle	On the last digit of announced quadrant, rotate rammer cylinder up to latched position. Release handle as soon as cylinder latches	Rammer cylinder rotated up to latched position and handle released	C1		Rammer cylinder properly rotated and in latched position and handle released (TM & SM)	Observe rammer cylinder properly rotated and in latched position and handle properly released
				Ram-cylinder Actuator Lever	Push ram-cylinder actuator lever IN until projectile seats (approximately 4 seconds) and then release actuator handle	Projectile rammed and seated	C1 (Self)		Projectile correctly rammed and seated (TM & SM)	Observe projectile properly seated
				Main Release Handle Cylinder Release Handle Pointer	Grip main release handle with right hand and cylinder release handle with left hand and pull rammer fully to rear; rotate rammer counter clockwise and push forward to stowed position; check pointer is in black band	Rammer in forward, stowed position; pointer in black band	C1 (Self)		Rammer properly in forward, stowed position; pointer correctly returned to black band (TM & SM)	Visually observe rammer in proper forward, stowed position and pointer correctly returned to black band
		C4	Propellant charge received	Propellant Charge	Place propellant charge 3 inches inside rear of chamber or in groove with red side showing	Propellant charge placed inside rear of chamber with red side showing	C1		Propellant charge properly loaded with red side showing (TM & SM)	Visually observe propellant charge loaded properly with red side showing

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer
Section Position(s): C1
Prequisites: Fire Command; Howitzer in Firing Position, Tube at Loading Elev., Breech Open; Prepared Round
Task Classification: [X] Procedural (Fixed, Structured) [ ] Variable (Cognitive, Semi-Structured)

Revision 1 Date: 2/8/84
Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
				Operating Cam Handle	Visually insure red igniter pad showing, announce "CLOSE" and lift operating cam handle	Breechblock closed	C1		Breechblock correctly closed (TM & SM)	Hear "CLOSE" and visually observe breechblock closed correctly
				Witness Marks	Visually insure witness marks are aligned. If not: Release operating handle and push clutch pin in; hold in and push forward on operating handle which will rotate breechblock closed	Witness marks aligned	C1 (Self)		Witness marks correctly aligned (TM)	Visually observe witness marks aligned
				Primer	Insert primer into primer chamber with flanged head of primer firmly seated against extractor	Primer inserted in chamber with flanged head seated firmly against extractor	C1 (Self)		Primer properly inserted in chamber with flanged head seated firmly against extractor (TM & SM)	Visually observe primer properly inserted and flanged head seated firmly against extractor
				Firing Mechanism Block Assembly Follower Knob	Push follower knob to slide firing mechanism block all the way to the left	Firing mechanism block all the way to the left	C1 (Self)		Firing mechanism block correctly located all the way to the left (TM)	Visually observe firing mechanism block located all the way to the left

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): C1

Prequisites: Fire Command; Howitzer in Firing Position; A Swab and Bucket of Water

Task Classification:
[x] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 1/26/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
Fire Howitzer SM Task # & Name 061-270-1507 Load and Fire a Prepared Round (M109 Series) TRI: 61 References/Notes • FM6-13B (Pg. 6-12) • TM9-2350-303-10 (Chapter 2) This analysis covers firing only.	8) Work space restriction 9) Personal Equipment and/or clothing 10) Operational state	C1 (Self)	Firing mechanism block located in firing position	Lanyard Firing Mechanism Lever	Attach lanyard to eyelet of firing mechanism lever	Lanyard attached to firing mechanism lever	C1 (Self)	00:00	Lanyard properly attached to firing mechanism lever (TM)	Observe lanyard properly attached to firing mechanism lever
		Ch Sec	Command to fire—WR or AMC	Lanyard	Fire howitzer with continuous pull on lanyard on the command "FIRE"	Howitzer fired	C1 (Self)		Howitzer is fired properly without delay (SM & TM)	Observe howitzer fired. Time from "FIRE" command to actual weapon firing
				Breechblock Operating Handle Detent Plunger Operating Handle	Open breechblock by depressing operating handle detent plunger; pull operating handle rearward until operating crank roller is engaged in cradle cam; and return operating handle to stowed position (forward)	Breechblock open and operating handle in stowed position	C1 (Self)		Breechblock opened correctly and operating handle in forward, stowed position (TM & SM)	Observe breechblock open and operating handle in forward, stowed position
				Pointer	Check pointer is in black band indicating rammer is properly stowed and latched	Pointer is in black band and rammer is properly stowed and latched	C1 (Self)		Rammer properly stowed and latched; pointer in black band (TM)	Visually observe rammer properly stowed and latched; pointer correctly returned to black band
				Swab Bucket of Water	Swab and inspect powder chamber and obturator head	Powder chamber and obturator head swabbed and inspected	C1 (Self)		Powder chamber and obturator head properly swabbed and inspected (TM & SM)	Observe powder chamber and obturator head swabbed and inspected

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer

Section Position(s): C1

Prequisites: Fire Command
Howitzer in Firing Position
A Swab and Bucket of Water

Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 1/26/84

Analyst: C. Preusser

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
				Tube	Inspect tube for obstructions and announce "BORE CLEAR" if unob-structed	Tube inspected and unobstructed and "BORE CLEAR" an-nounced	Ch Sec		Tube properly inspected and free of obstructions; "BORE CLEAR" properly announced with no delay (TM & SM)	Observe tube free of obstructions and hear "BORE CLEAR" announcement: time from "FIRE"

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Digital Comm. Estab'd w/FDC
Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/16/84
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equip-ment	Actions	Content	To			
Process Fire Commands	1a) Visibility environmental 5) Weather 9) Personal equipment and clothing	FDC	Displayed Fire Command: Audible alarm and message header	GDU (SCA)	Receive audible alarm and visual signals	Initiation of task	Self (Ch Sec)		Audible alarm and visual signals observed promptly (TM, TC)	None until CYCLE key is activated, or announcement is made
					Announce "Fire Mission," number of gun, number of mission, type of mission control	Announcement of fire mission, number of gun, number of mission, type of mission control	G AG C		Announcement made accurately and in correct format (TM, FM)	Compare announcement with data and format guidelines
SM Task # & Name				SCA	Press CYCLE key	Acknowledgment signal	FDC		Key is pressed promptly; ACK received promptly by FDC (TM, TC)	ACK received by FDC
Operate Gun Display Unit (Section Chiefs Assembly)				SCA	Observe ACK in display window	Decision that ACK was sent	Self (Ch Sec)		ACK is observed properly by Ch Sec (TM)	Ch Sec proceeds to next appropriate step
TRI: Unknown		FDC	Fire mission data (stored in SCA)	SCA	Cycle through Fire Mission Commands	(See below)			(See below)	(See below)
References/Notes				SCA	Press appropriate keys to display data	Display of next or requested fire mission message element	Self (Ch Sec)		Appropriate key is pressed without delay	Observe promptness of cycling
• TC6-1-2 (May 83) • TM11-7440-283-12-2				SCA	Read/announce data from Command bar and sequential display window: • Type of mission • Type of mission control • Special instructions • Shell • Lot • Rounds • Charge • Fuze • Deflection • Time • Q elevation	Announcement of next or requested fire mission message element or command	G AG C		Message element is correctly announced (FM)	Compare displayed with announced message element

GUNNERY TEAM ENGAGE INPUT-PROCESS-OUTPUT (IPO) ANALYSIS

Subsystem: Howitzer Section
Section Position(s): Chief of Section
Prequisites: Digital Comm. Estab'd w/FDC
Task Classification:
[X] Procedural (Fixed, Structured)
[ ] Variable (Cognitive, Semi-Structured)

Revision 0 Date: 3/16/84
Analyst: R. Bloom

Function(s)/Tasks	Factors Affecting Performance	Inputs		Process		Outputs		Time (min:sec)	Performance Standard(s)	Present Assessment Method
		From	Content	Equipment	Actions	Content	To			
		G, AG, C	Repeated commands		Hear repeated commands	Decision that commands were heard	Self (Ch Sec)		Commands are correctly repeated (FM)	Compare announced with repeated commands
		G, AG, C	Request repeat of commands		Hear requests for repeating commands	Decision to repeat commands	Self (Ch Sec)		Repeat requests are correctly heard (FM)	None, until command is repeated
				SCA	Repeat commands as needed	Repeated command	G, AG, C		Command is repeated correctly (FM)	Compare displayed with announced command
				SCA	• If safe and ready, press READY	READY message	FDC		READY message is received by FDC (TM, TC)	Compare sent with received READY message
		FDC	If AMC, command to fire (FIRE)	SCA	• If AMC, receive alarm and the command to FIRE; send acknowledgment	Acknowledge (ACK) message	FDC		Audible and visual signals observed promptly (TM, TC)	Compare sending of message and ACK at FDC
				SCA	• If proper fire, press SHOT/RC after each round is fired	SHOT/RC message	FDC		SHOT/RC message is correctly received (TM, TC)	Compare time of fire with receipt of message at FDC
				SCA	• Successively press CYCLE or other SCA keys and announce as needed	Message elements	Self (Ch Sec)		Desired message element is correctly acquired and announced (TM, TC)	Compare desired with acquired and announced messages for accuracy and consistency
				SCA	• Press SHOT/RC one extra time after final round is fired	SHOT/RC message, twice (final round)	FDC		SHOT/RC message is correctly and promptly received at FDC (TM, TC)	Compare fire time of final round with receipt of message at FDC

APPENDIX C

AGGREGATED TASKS AND TRAINING DEVICE ASSESSMENT

(Task Three Results)

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APPENDIX C

AGGREGATED TASKS AND TRAINING DEVICE ASSESSMENT
(Task Three Results)

Introduction

The results of Task Three have been summarized on pp. 9-11. Also, the "aggregated tasks" that were compiled in the course of Task Three have been used as the basis for the GTT System Requirements (Section V). That is to say they define the content of what the GTT is supposed to training the gunnery team to do. Because these particular results are especially useful in defining the GTT. the following figures summarizing them have been included here. Figure C-1, C-2 and C-3 show the aggregation of tasks in each of the subsystems. The central column of each is a list of the aggregated tasks while to the left are shown the component Soldier's Manual task numbers. This allows a "crosswalk" among this appendix, Appendix B and Appendix A. To the right of the aggregated list are shown the positions to which each task applies (this crosswalks with the Operational Sequence Diagram in Appendix A). Farther to the right is a summary of the training media assessment. This assessment was made on a task by task basis to determine the most feasible means of training each Soldier's Manual task. These assessments were averaged to obtain the number shown here for the aggregated task. The circled value denotes the most feasible medium for this named task. The TRI is the mean value of the Training Requirements Index assigned to each Soldier's Manual task. The index is discussed in Section VIII.

A summary of training device and simulator assessment is shown separately for each section of the gunnery team in Figures C-4, C-5 and C-6. The assessment was made for each device or simulation currently in the Field Artillery inventory. Because devices, simulations and operational equipment are included, the title of Training Technology Assessment was used. The ratings used are shown on each figure. In the body of the figure , the rating of each device for each aggregated task is shown. At the right side of each figure is a summary assessment of the extent of new device development required for each aggregated task. That assessment attempts to estimate the effort needed to produce a device suitable for completely training the named task.

Figure C-1.

Aggregated Engagement Tasks to be Trained

Forward Observer/Fire Support Team

SM TASK NUMBER																																		Engagement includes the following topics (aggregated) to be trained in a team setting	Section Position Trained			Training Media Assessment (Mean)						Aggregate TRI (Mean)
061-273-1003	061-274-3973	061-274-3974	061-274-3976	061-274-3977	061-274-3979	061-274-3980	061-274-3986	061-274-3989	061-283-1001	061-283-1002	061-283-1003	061-283-1004	061-283-1011	061-283-1013	061-283-1014	061-283-1015	061-283-1021	061-283-1052	061-283-1952	061-283-1953	061-283-1959	061-283-2001	061-283-2002	061-283-2003	061-283-2004	061-283-2005	061-283-2021	061-283-2022	061-283-2101	061-283-2102	061-283-2103	061-283-2205	TBD C/C FM		FO	FIST Ch	FS Sgt	Instr Alone	Instr Demo Mtls	TDs	Sims	Aug Opl Eqt	Opl Eqt	
X					X	X	X	X	X				X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	1. Using the DMD and FIST DMD to prepare, transmit, receive and forward messages related to all fire missions.	X DMD	X FIST DMD	X FIST DMD	0.2	0.7	2.6	2.3	2.0	1.2	70
	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X						X	X	X			X	X		X	X	X		2. Using the GLLD to measure range and to illuminate targets; using on stationary or moving targets; using in daylight or night-time operations.	X	X	X	0.1	0.8	2.6	2.5	2.1	1.5	71
										X	X		X	X	X	X			X	X	X	X	X	X			X	X		X	X	X		3. Using the LRF to measure range.	X	X	X	0.1	0.7	2.8	2.6	2.2	1.3	73
	X				X		X		X	X	X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	4. Using visual/manual devices (map, plotting equipment, binoculars, compass) for: determining object location, altitude; recording data; drawing and using terrain sketch.	X	X	X	0.2	1.0	2.6	2.4	1.9	1.6	71
	X	X	X	X	X	X		X					X	X	X	X	X					X	X	X	X	X	X	X		X	X	X		5. Decision-making related to all fire missions. Including: a) Target detection, identification, classification, threat assessment and location relative to zone of responsibility. b) Target selection, based on threats, priorities and commander's guidance. c) Command fire to engage selected target (fire, adjust fire data). d) Evaluate mission to determine call for further adjustment or EOM. e) Safe operating procedures.	X	X	X	0.8	1.9	1.8	2.8	1.4	1.1	75
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		6. Timely operation under stated environmental conditions.	X	X	X	0.0	0.0	1.7	2.8	2.1	1.4	70

Figure C-2.

Aggregated Engagement Tasks to be Trained

Fire Direction Center

SM TASK NUMBER														Engagement includes the following topics (aggregated) to be trained in a team setting	Section Position Trained	Training Media Assessment (Mean)						Aggregate TRI (Mean)
061-279-2002 BCS	061-279-2003 BCS	061-279-2004 BCS	061-279-2002 TACF	061-279-2003 TACF	061-279-2004 TACF	061-279-2005 BCS	061-279-2011	061-279-2016 TACF	061-279-2017 BCS	061-280-1001	061-280-3000	TBD (FP) TACF	TBD COPPERHEAD			Instr Alone	Instr Demo Mtls	TDs	Sims	Aug Opl Eqt	Opl Eqt	
X	X	X							X		X		X	1. Using BCS to process and evaluate RFAF (Autonomous) messages related to adjust fire, fire-for-effect, quick fire and Copperhead (target-of-opportunity) missions.	BCS Operator (Computer)	0.0	0.6	(2.4)	(2.4)	2.0	1.1	76
			X	X	X		X	X			X	X		2. Using BCS to process TACFIRE messages related to adjust fire, fire-for-effect, time on target and and specified fire plan missions.	BCS Operator (Computer)	0.0	0.4	(2.6)	2.0	2.0	1.1	77
						X	X			X	X			3. Plotting/replotting targets on map, using BCS to receive and transmit related data.	BCS Operator (Computer)	0.3	0.9	2.1	(2.6)	2.1	1.9	73
X	X	X	X	X	X	X	X	X	X	X	X	X	X	4. Timely operation under stated environmental conditions	BCS Operator (Computer)	0.0	0.0	1.8	(3.0)	1.9	1.0	74

Figure C-3.

Aggregated Engagement Tasks to be Trained

Howitzer Section

SM TASK NUMBER									Engagement includes the following topics (aggregated) to be trained in a team setting	Section Position Trained					Training Media Assessment (Mean)						Aggregate TRI (Mean)
061-266-1506	061-266-2229	061-266-3315	061-266-3318	061-266-3322	061-270-1507 (L)	061-270-1507 (P)	061-271-1215	TBD		ChSec	G	AG	C1	C2,3,4,HD	Instr Alone	Instr Demo Mtls	TDs	Sims	Aug Opl Eqt	Opl Eqt	
X	X	X	X		X		X	X	1. Using GDU/SCA and/or voice to receive, annouce and repeat communications related to all fire missions.	X (GDU/ SCA & Announce)	X Rpt by voice	X Rpt by voice	X Rpt by voice	X Rpt by voice	0.1	0.6	1.9	(2.6)	2.2	2.0	57
X		X		X	X				2. Initiating, observing, evaluating and correcting operating procedures/ conditions to insure safe handling and firing of the howitzer and ammunition.	X			X	X	0.7	1.7	(2.2)	1.7	2.0	1.8	61
	X		X				X		3. Aiming the Howitzer in elevation and deflection, using the elevation quadrant/range quadrant/direct fire scope and the pantel/collimator, respectively.	X Gunner's Quadr Coord W/G	X Deflection Collimator	X Elev'n Range Quadr			0.2	0.7	1.5	1.7	(3.0)	2.2	54
X					X	X			4. Loading, firing and clearing the Howitzer.				X load breech fire swab clear	X shell fuze charge	0.3	1.0	(2.8)	2.3	1.3	2.0	61
X	X	X	X	X	X	X	X	X	5. Timely operation under stated environmental conditions.	X	X	X	X	X	0.0	0.0	1.6	(2.6)	2.0	1.8	58

Figure C-4.

TRAINING TECHNOLOGY: ADEQUACY AND NEW REQUIREMENTS

Forward Observer/Fire Support Team

Engagement includes the following topics (aggregated) to be trained in a team setting	Adequacy of Existing Training Devices (Absent, Poor, Fair, Good, Excellent, Not Applicable)							Need for New Training Technology (None, Minor, Moderate, Major)
	1. Uninstrumented Operational Equipment	2. G/VLLD Trainer	3. G/VLLD with TV Camera	4. Training Set Fire Observation (TS FO)	5. Forward Observer Trainer	6. Miniature Moving Target	7. Battle Simulations	
1. Using the DMD and FIST DMD to prepare, transmit, receive and forward messages related to all fire missions.	Fair	N/A	N/A	N/A	N/A	N/A	Fair	Moderate
2. Using the GLLD to measure range and to illuminate targets; using on stationary or moving targets; using in daylight or nighttime operations.	Poor	Good	Good	N/A	N/A	Good	Poor	Minor
3. Using the LRF to measure range.	Poor	N/A	N/A	N/A	N/A	Good	Poor	Minor
4. Using visual/manual devices (map, plotting equipment, binoculars, compass) for: determining object location, altitude; recording data; drawing and using terrain sketch.	Fair	N/A	N/A	Good	Fair	N/A	Good	Moderate
5. Decision-making related to all fire missions including: a) Target detection, identification, classification, threat assessment and location relative to zone of responsibility. b) Target selection, based on threats, priorities and commander's guidance. c) Command fire to engage selected target (fire, adjust fire data). d) Evaluate mission to determine call for further adjustment or EOM. e) Safe operating procedures.	Absent	N/A	N/A	Fair	Fair	Good	Good	Moderate
6. Timely operation under stated environmental conditions.	Poor	Poor	Poor	Fair	Poor	Fair	Fair	Major

Figure C-5.

TRAINING TECHNOLOGY: ADEQUACY AND NEW REQUIREMENTS

Fire Direction Center

Engagement includes the following topics (aggregated) to be trained in a team setting	Adequacy of Existing Training Devices (Absent, Poor, Fair, Good, Excellent, Not Applicable)			Need for New Training Technology (None, Minor Moderate, Major)
	1. Uninstrumented Operational Equipment	2. Battery Computer System Interface Training Simulator (BCS/ITS)	3. Battle Simulations	
1. Using BCS to process and evaluate RFAF (Autonomous) messages related to adjust fire, fire-for-effect, quick fire and Copperhead (target-of-opportunity) missions.	Fair	Good	Fair	Minor
2. Using BCS to process TACFIRE messages related to adjust fire, fire-for-effect, time on target and specified fire plan missions.	Poor	Good	Fair	Minor
3. Plotting/replotting targets on map, using BCS to receive and transmit related data.	Poor	Fair	Good	Moderate
4. Timely operation under stated environmental conditions.	Absent	Poor	Fair	Major

Figure C-6.

TRAINING TECHNOLOGY: ADEQUACY AND NEW REQUIREMENTS

Howitzer Section

Engagement includes the following topics (aggregated) to be trained in a team setting	Adequacy of Existing Training Devices (Absent, Poor, Fair, Good, Excellent, Not Applicable)											Need for New Training Technology (None, Minor, Moderate, Major)
	1. Uninstrumented Equipment	2. Firing Battery Trainer	3. Artillery Direct Fire Trainer	4. Multiple Integrated Laser Engagement System	5. M31 Subcaliber Trainer	6. Miniature Moving Target (with M31)	7. FA Shootable Practice Round	8. Training Projectiles and Fuzes	9. Low Cost Indirect Training Round	10. Battery Computer System / Interface Training System	11. Battle Simulations	
1. Using GDU/SCA and/or voice to receive, announce and repeat communications related to all fire missions.	Poor	Good	N/A	N/A	N/A	Fair	N/A	N/A	N/A	Good	Fair	Minor
2. Initiating, observing, evaluating and correcting operating procedures/conditions to insure safe handling and firing of the howitzer and ammunition.	Absent	Poor	Fair	Fair	Poor	Fair	Fair	Poor	Fair	N/A	Poor	Moderate
3. Aiming the howitzer in elevation and deflection, using the elevation quadrant/range quadrant/direct fire scope and the pantel/collimator, respectively.	Absent	Good	Poor	Poor	Poor	Good	N/A	N/A	Poor	N/A	Poor	Minor
4. Loading, firing and clearing the howitzer.	Absent	Good	Poor	Poor	Poor	Fair	Fair	Poor	Fair	N/A	Poor	Minor
5. Timely operation under stated environmental conditions.	Absent	Poor	Poor	Poor	Poor	Poor	Poor	N/A	Poor	Poor	Fair	Major